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NATIONAL DAM INSPECTION PROGRAM. CURTIS DAM (NDI ID NUMBER PA-0--ETC(U)
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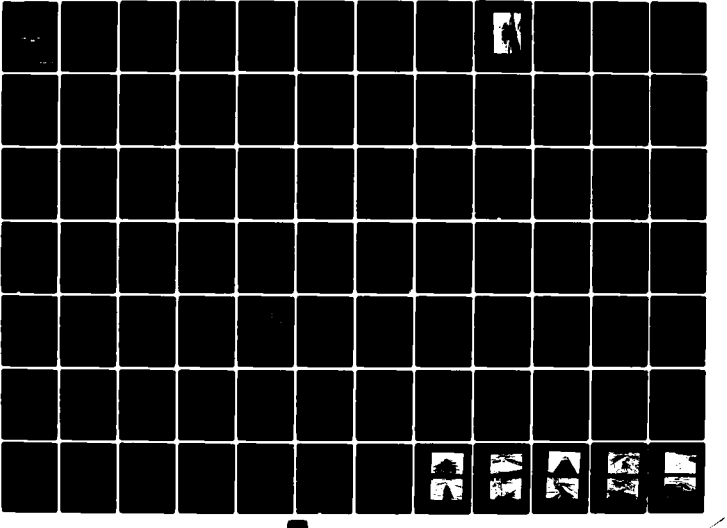

SUSQUEHANNA RIVER BASIN
WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM
NDI ID NO. PA-00370
DER ID NO. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

APRIL 1979

(15) DACW31-79-C-0015 (1)

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA (10) Albert Charles/Hoke

(6) National Dam Inspection Program.

CURTIS DAM

(NDI ID Number PA-0037Ø
DER ID Number 35-17),

~~PENNSYLVANIA GAS AND WATER COMPANY~~,
Susquehanna River Basin, White Oak Run,
Lackawanna County, Pennsylvania.

PHASE I INSPECTION REPORT,

NATIONAL DAM INSPECTION PROGRAM

Prepared by (12) 100

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

(11) APRIL 79

411004

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

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1	Location Map.
2	Plan.
3	Plan, Profile, and Spillway Sections.
4	Embankment Sections.
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A	Checklist - Engineering Data.
B	Checklist - Visual Inspection.
C	Hydrology and Hydraulics.
D	Photographs.
E	Geology.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Curtis Dam NDI ID No. PA-00370/DER ID No. 35-17
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	White Oak Run
Date of Inspection:	7 November 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on visual inspection, available records, calculations, past operational performance, and according to criteria established for these studies, Curtis Dam is judged to be unsafe, nonemergency, because the spillway capacity is rated as seriously inadequate. The existing spillway can pass 17 percent of the Probable Maximum Flood (PMF) without overtopping of the dam. The resulting outflows from the failure of Curtis Dam would probably overtop and cause the failure of Elmhurst Dam. This would result in the loss of life. As a whole, the dam is judged to be in fair condition.

If the low areas of the top of the embankment were raised 1.1 feet to the design elevation and if the low areas of the dike were raised 2.0 feet to the design elevation, the spillway could pass 46 percent of the PMF. The spillway capacity would still be rated as seriously inadequate.

There is no evidence of stability problems on the embankment. The spillway and auxiliary spillway sections meet the OCE guidelines for stability. A length of the left spillway training wall has failed.

The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform a study to more accurately ascertain the spillway capacity required for Curtis Dam as well as the nature and extent of the mitigation measures required to make the spillway hydraulically adequate. Take appropriate actions as required. The studies should be performed by a professional engineer experienced in the design and construction of dams.

(2) Raise the embankment and the earthfill at the dike and floodwall to the design elevation.

(3) Perform a study to ascertain the remedial measures required at the spillway area to correct deficiencies. This study should address the deteriorated mortar and concrete at the spillway, auxiliary spillway, auxiliary spillway apron, and spillway channel. The study should also address the structural stability of the left training wall, the hydraulic adequacy of the auxiliary spillway apron, and the scour potential beneath the downstream bridge. Take appropriate action as required. The section of wall lying in the spillway channel should be removed immediately. The study should be performed by a professional engineer, as noted above.

(4) With the reservoir at normal pool level, inspect the embankment, dike, and floodwall for wet areas and seepage. Take appropriate action as required.

(5) Perform a study to ascertain the structural adequacy of the floodwall and dike. Take appropriate action as required. The study should be performed by a professional engineer, as noted above.

(6) Repair the capstones on the spillway right training wall and the outlet works approach wall.

(7) Monitor by any suitable means the swell on the upstream slope of the embankment. If changes are noted, take immediate remedial action.

(8) Extend the riprap to the top of the dam.

(9) Provide a drain in the valve pit.

(10) Remove brush from the downstream toe of the floodwall and dike, as well as on the upstream slope of the embankment.

In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Curtis Dam.

(2) Develop impediments to trail bike use on or near the dam.

(3) During periods of unusually heavy rains, provide round-the-clock surveillance of Curtis Dam.

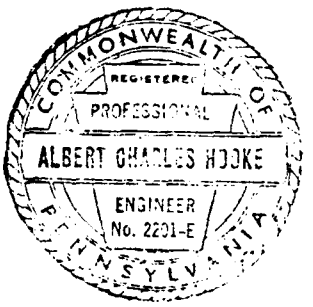
(4) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

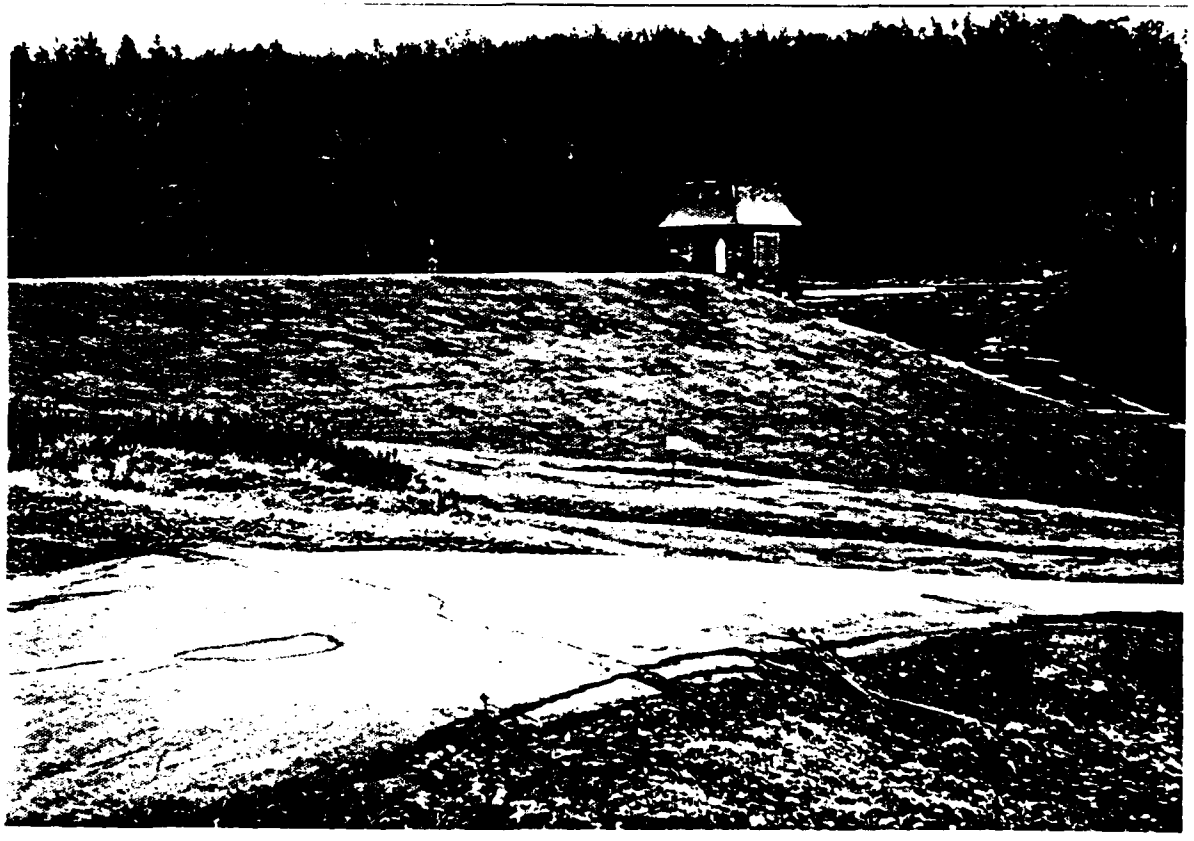
Date: 30 April, 1979



Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

CURTIS DAM



Overview

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Curtis Dam is a homogeneous earthfill embankment with a masonry core-wall. The embankment is 203 feet long and 45 feet high at maximum section. A masonry gravity retaining wall, which acts as the spillway right training wall, is at the left end of the embankment. The outlet works,

which is at the left end of the embankment, consists of a masonry intake structure, a valve pit, and an outfall. The outfall discharges into the spillway discharge channel.

The masonry gravity main spillway extends to the left of the intake structure. Its crest is 4.0 feet below the design elevation of the top of the dam and is 52.3 feet long. The auxiliary spillway extends to the left of the main spillway. Its crest is 0.5 feet above the main spillway crest elevation and is 56.9 feet long. The auxiliary spillway discharges onto an apron that extends to the spillway channel. The spillway channel has a variable bottom width and a concrete gravity training wall on the left. The channel extends to a bridge just downstream of the toe of the dam.

A masonry gravity floodwall, which is 7 feet high at maximum section, extends for 371 feet upstream from the right abutment of the embankment. Its axis is about normal to the axis of the dam. The floodwall retains an earthfill along the right side of the reservoir. The earthfill extends about 450 feet upstream from the floodwall and acts as a dike. The purpose of the floodwall and dike is to prevent flooding of a railroad along the right shore of the reservoir. The railroad is abandoned.

b. Location. The dam is located on White Oak Run approximately 2.6 miles north of Moscow, Pennsylvania. Curtis Dam is shown on USGS Quadrangle, Moscow, Pennsylvania, with coordinates N41°22'30" and W75°30'50" in Lackawanna County, Pennsylvania. Most of the reservoir is shown on USGS Quadrangles; Olyphant and Lake Ariel, Pennsylvania. Elmhurst Dam is located downstream of Curtis Dam on Roaring Brook 1.4 miles west of Curtis Dam. White Oak Run flows into Elmhurst Reservoir. A location map is shown on Plate 1.

c. Size Classification. Intermediate (45 feet high, 1,632 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Curtis Dam (Paragraph 5.1c.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Water supply for the communities of Dunmore and Scranton, Pennsylvania.

g. Design and Construction History. Curtis Dam was built between 1886 and 1887 by the Scranton Gas and Water Company. The dam was designed by E. Sherman Gould, Consulting Engineer. It was constructed by Burke Brothers, Contractors of Scranton, Pennsylvania, under the supervision of William M. Marple.

In 1895, the downstream slope was flattened to its present configuration. The spillway right training wall was raised at that time.

In 1899, the spillway crest was raised by 1.5 feet to increase the storage capacity.

During the original inspection by the Pennsylvania Water Supply Commission in July, 1914, the dam had just been overtopped. The nonoverflow section (at the site of the present auxiliary spillway) was overtopped by 1 foot. The dike at the right side was also overtopped along a 15-foot length.

The Report on the dam prepared by the Pennsylvania Water Supply Commission was actually a report on the Owner's proposed repairs to the damage that was caused by the overtopping. The repairs consisted of paving with masonry the area at the downstream toe of the nonoverflow section, which had been eroded during the overtopping. The Report recommended adding an abutment section to the left of the nonoverflow section, thus making the nonoverflow section an auxiliary spillway. It also recommended that the low areas on the top of the embankment be filled in. The work was completed in 1916.

In 1928, a flood eroded more material at the toe of the auxiliary spillway. The auxiliary spillway apron was extended to its present configuration in the same year to prevent further damage.

h. Normal Operational Procedure. The pool is maintained at spillway crest with excess inflow discharging over the spillway. Releases from the outlet works, as well as spillway discharges, flow downstream to Elmhurst Dam.

1.3 Pertinent Data.

a. Drainage Area. (square miles). 2.4

b. Discharge at Damsite. (cfs).

Maximum known flood at damsite.(1)	470
Outlet works at maximum pool elevation. (approximate).	250
Spillway capacity at maximum pool elevation.	
Existing Conditions:	
Main spillway.	490
Auxiliary spillway.	290
Total	780
Design Conditions:	
Main spillway.	1,320
Auxiliary spillway.	1,020
Total	2,340

c. Elevation. (feet above msl.).

Top of dam (design).	1499.8
Top of dam (existing).	1497.8
Maximum pool.	1497.8
Normal pool. (spillway crest)	1495.8
Upstream invert outlet works.	Not Available
Downstream invert outlet works.	1464.9
Streambed at toe of dam.	1454.3

(1) See Section 5 for a discussion of the flood of record.

d. Reservoir Length. (miles).

Normal pool.	1.46
Maximum pool.	1.52

e. Storage. (acre-feet).

Normal pool.	1,285
Maximum pool (design conditions)	1,632

f. Reservoir Surface. (acres).

Normal pool.	75
Maximum pool (design conditions).	99

g. Dam.

Type	Earthfill with masonry core-wall A masonry gravity floodwall and dike extend along the right abutment.
Length (feet)	
Embankment	203
Floodwall	371
Dike	450
Height (feet)	
Embankment	45
Floodwall	7
Dike (approximate)	4
Topwidth (feet)	
Embankment	10
Floodwall (masonry only)	4
Dike (approximate)	10
Side Slopes	
Embankment	
Upstream	1V on 3H
Downstream	1V on 3H Except 1V on 6H near toe.
Dike	
Upstream	1V on 3H
Downstream	Irregular
Zoning	Homogeneous earthfill.
Cutoff	Core-wall and floodwall.
Grout Curtain	None.

h. Diversion and Regulating Tunnel. None.

i. Spillways.

Main Spillway	
Type	Masonry gravity weir with inclined top.
Length of Weir (feet).	52.3
Crest Elevation	1495.8
Upstream Channel	Reservoir.
Downstream Channel	Variable bottom width, steep rectangular channel extending beyond the toe of the embankment.
Auxiliary Spillway	
Type	Broad-crested masonry gravity weir.
Length of Weir (feet).	56.9
Crest Elevation	1496.3
Upstream Channel	Reservoir.
Downstream Channel	Paved apron extending to spillway channel.

j. Regulating Outlets.

Type	Single cast-iron 36-inch diameter pipe.
Length (feet).	37
Closure	Gate valve at downstream end.
Access	Rungs in right training wall leading to valve pit downstream of masonry intake structure.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No engineering data were available for review for the structure as originally designed or for the modifications of 1895 and 1899. In a study performed in 1914 by the Pennsylvania Water Supply Commission an account of design concepts, geology, construction materials and methods, and design features was prepared for the components of the dam from interviews with the Owner, visual inspection, and other sources. The 1914 study also included analyses for hydrology and hydraulics and structural stability. A summary of the results of the analyses is on file. Some engineering data for the subsequent modifications were available.

b. Design Features. The project is described in Paragraph 1.2g. The various features of the dam are shown on Plate 2 and on the photographs in Appendix D. Plate 2 does not show the extended auxiliary spillway apron that was constructed in 1928. It is shown on Photograph F. Plate 3 and Photographs D and E show details of the main spillway and the auxiliary spillway. Plate 4 shows the embankment and typical floodwall sections. These features are shown on Photographs A and I. Plate 5 and Photographs D and G show the spillway channel and outlet works. Some of the Plates were traced from the Owner's drawings, because the originals did not yield reproducible copies.

c. Design Considerations. There are no particular concerns about the original design. The structural adequacy of the spillway channel left training wall, which was constructed during a modification to the dam, is addressed in Section 6. The freeboard of the auxiliary spillway apron wall, which is also a modification to the dam, is addressed in Section 5.

2.2 Construction.

a. Data Available. Construction data for the original structure that are available for review, consists of the information contained in the 1914 Report prepared by the Pennsylvania Water Supply Commission. The information is relatively well detailed. It reports that the embankment was constructed of clay, gravel, loam, and sand that was placed in layers and sprinkled during placement. Compaction was accomplished by the earth-moving equipment passing over the embankment. The masonry core-wall was reportedly founded below the natural ground on what was considered to be a "cementitious and impervious formation". A discussion on site geology is presented in Appendix E. The Report also states that the foundation of the masonry gravity spillway section was carefully excavated by hand, and that each masonry block was very carefully bedded with mortar.

b. Construction Considerations. The available information indicates that the dam was well constructed. Although the embankment could have been compacted better, it has existed for 92 years without any reported problems.

2.3 Operation. There are no formal records of operation. The main items regarding the operational history of the dam are the overtopping in 1914 and the failure of the spillway left training wall. The Owner did not report any other problems having occurred over the operational history of the dam.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dam Safety, Obstructions, and Storm Water Management, Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, Pennsylvania Gas and Water Company. The Owner made available a caretaker for information during the visual inspection. He also researched his files for further information at the request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data are limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is fair. Deficiencies were observed as noted below. A sketch of the dam with the location of deficiencies is presented in Appendix B on Plate B-1. Survey information acquired for this report is summarized in Appendix B. On the day of the inspection, the pool was 20.6 feet below spillway crest, because the reservoir had recently been emptied to fill Elmhurst Reservoir.

b. Embankment. The embankment appears to be in good condition. The grass cover is in excellent condition. The upstream slope is swelled for an area 20 feet by 40 feet near the left end and about 10 feet below spillway crest elevation. A section through this area is shown on page B-11. Trail bike ruts extend up the downstream right abutment of the embankment. At the lower end of the trail bike ruts is a 4-foot square area of soil with its grass cover missing. Near the upper end of the trail bike ruts, near the top of dam, is a similar 10-foot square area. A drainage swale, which runs along the toe of the floodwall, extends down the right abutment. The riprap on the upstream slope is in good condition. The top of the riprap is about 3 feet below the design top elevation of the dam (Photograph C). There is a minor amount of brush along the top of the upstream slope. The survey performed for this inspection revealed that the upstream and downstream slopes are both 1V on 3H, except that the lower downstream slope is 1V on 6H. There are some low areas at the top of the embankment. The lowest area is 1.1 feet below the design elevation. This area appears to have been purposefully constructed low. It is adjacent to the intake structure (Photograph D). Other low areas occur along the floodwall and dike as described hereafter.

c. Appurtenant Structures. The outlet works appears in good condition. The outlet works valve was opened about 5 percent by two men in 10 minutes without any problems. The valve pit contained water. The caretaker reported that the pit is not drained. It appears that access to the pit would be hazardous during large spillway discharges. On the approach wall, upstream of the intake structure, a capstone is dislodged.

The main spillway and the auxiliary spillway are in fair condition. The mortar on both spillways is deteriorated, and in some cases is missing almost completely. The condition is particularly severe on the uppermost 2 feet of the auxiliary spillway.

The auxiliary spillway apron and the spillway outlet channel are in poor condition. The mortar in the auxiliary spillway wall is deteriorated. The concrete (shotcrete) paving on the auxiliary spillway apron is almost completely eroded. The apron and wall do not appear to be of sufficient size to contain the auxiliary spillway discharge capacity. Relevant dimensions for this area are shown in Appendix B. Where the apron joins the spillway outlet channel, the concrete is severely scoured. The mortar between the paving stones on the bottom of the spillway outlet channel is about 95 percent eroded. The left spillway training wall is tilted. The entire wall exhibits peeling and pattern cracking. There is severe scour along the bottom of this wall; the largest single area scoured is 10 feet long and 1.5 feet deep (Photograph G). Near the downstream end of this channel, a 9-foot length of wall is offset. Immediately adjacent, another 9-foot length is lying on its side (Photograph H). There is some evidence of soil movement behind this section of the wall. The bridge at the downstream end of the channel has a scour hole on the bottom. The right training wall is leaching along its lower face. The capstones on the top of the wall show evidence of deterioration.

The floodwall and dike along the right side of the reservoir are in fair condition (Photograph I). Along a reach of the floodwall, the overlying soil appears to

have pushed the capstone off its original position. The maximum movement measured 6 inches. Brush covers the downstream face of the floodwall and the longitudinal extent of the movement was not able to be measured. Upstream of the floodwall, on the dike, minor sloughing was observed along the downstream side. An area of the dike appears to have been washed out. This area is 2.0 feet below the design elevation of the top of the dam. Other areas along the top of the dike are low, as shown in Appendix B.

d. Reservoir Area. Some of the watershed is owned and controlled by the Pennsylvania Gas and Water Company. The watershed is mostly wooded rolling hills, with some farm fields and sparse suburban development.

e. Downstream Conditions. Immediately downstream from the dam, the stream passes under a bridge which conveys a small public road. The stream flows for 0.4 mile in a steep channel to Elmhurst Reservoir. In the above reach, which is uninhabited, the stream passes under an abandoned bridge that belongs to Pennsylvania Gas and Water Company. The access route to the dam generally parallels the stream and is high above it.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest, Elevation 1495.8, with excess inflow discharging over the spillway and into White Oak Run. White Oak Run flows into Roaring Brook at Elmhurst Reservoir 0.4 mile downstream. A 36-inch diameter cast-iron water supply line discharges into White Oak Run. Since streamflow is usually augmented only when Elmhurst Reservoir is below spillway crest elevation, the valve on the Curtis Dam water discharge line is usually closed.

4.2 Maintenance of Dam. The dam is visited twice a week by two caretakers who record the reservoir elevation. Weekly reports are mailed to the Owner's Engineering Department. This information is used by the Owner's Engineering Department for regulating flows in the distribution system. The caretakers are also responsible for observing the general condition of the dam and appurtenant structures and reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are filed and used for determining the priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 Maintenance of Operating Facilities. The outlet works valve is operated annually. In response to the National Dam Inspection Program of the previous year, the Owner is in the process of modifying his maintenance procedures. Details of the procedures have not been fully formulated.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a verbal description of the chain of command diagram for Curtis Dam and of a generalized emergency notification list that is applicable for all of the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe

conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formerly established for Curtis Dam, but are as directed by the Owner's Engineering Department.

4.5 Evaluation Of Operational Adequacy. The operational procedures appear satisfactory. The maintenance of the embankment is good. The maintenance of the floodwall, dike, and spillway is poor. The procedures used by the Owner for inspecting the dam are adequate, but many needed repairs have not been made. In general, the warning system is adequate, but it would be more effective if it were more detailed.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. No data were available for review for the structure as originally designed. During 1914, a report on the dam was prepared by the Pennsylvania Water Supply Commission. The report estimated the maximum spillway capacity at 580 cfs. The dam was subsequently modified, which increased the spillway capacity. No subsequent estimate of the spillway capacity was available for review. A discharge capacity of 2,340 cfs, with the embankment at its design elevation, was estimated and used in this report (Appendix C).

b. Experience Data. The Owner stated that no records of maximum pool levels were available. As was noted in Paragraph 1.2g, the dam was overtopped in 1914. The estimated flow from this overtopping is 470 cfs, not including flow over the dike that was also overtopped. This is used as the flood of record.

c. Visual Observations.

(1) General. The visual inspection of Curtis Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Embankment. The low areas on the top of the embankment reduce the spillway discharge capacity. The reason for intentionally making an area at the top of the embankment below the design elevation is unclear; it may have been intended to allow easier access to the intake structure. The riprap being below the top of the dam is an erosion hazard when the pool is above spillway crest elevation.

(3) Appurtenant Structures. No deficiencies were observed during the operation of the outlet works. Not draining the valve pit could hinder access to the valve. It may also allow the undrained water to freeze, thus damaging the valve. Although access to the valve pit may be hazardous during periods of high spillway discharge, this is not considered a deficiency because the outlet works discharge is negligible during a flood.

Most of the conditions in the main spillway, auxiliary spillway, and spillway channel are evaluated in Section 6. The dimensions of the auxiliary spillway apron and its associated wall are such that large discharges would either overtop the wall or shoot over the apron completely. This would be an erosion hazard. The length of wall lying in the spillway channel could restrict flow and raise the water surface sufficiently to pose an erosion hazard at the downstream toe of the embankment. The scour hole under the bridge is undoubtedly caused by the lack of channel paving under the bridge and by the deflection of the channel centerline at this point. The limits of the scour did not appear to be very extensive.

The low areas on the top of the floodwall and the dike reduce the spillway discharge capacity. Judging by the apparent washout on the dike, either the overtopping damage of 1914 was never repaired or the dike has been overtopped since then.

(4) Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam. The assessment of the dam is based on existing conditions, and the effects of future development are not considered.

(5) Downstream Conditions. No conditions were observed downstream from the dam that might present significant hazard to the dam. A Phase I Report for the National Dam Inspection Program was previously prepared for Elmhurst Dam. In that report, the spillway of Elmhurst Dam, which is a high hazard, intermediate size dam, was rated as inadequate. A failure of Elmhurst

Dam would cause loss of life in the community of Elmhurst immediately downstream; the failure of the dam would also cause the failure of No.7 Dam, which is downstream. From No.7 Dam, Roaring Brook flows through the center of Scranton. Because failure of Curtis Dam could cause failure of Elmhurst Dam during certain conditions, a high hazard classification is warranted for Curtis Dam. Access to Curtis Dam is excellent.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the spillway design flood (SDF) for the size (Intermediate) and hazard potential (High) of Curtis Dam is the probable maximum flood (PMF).

(2) Description of Model. The watershed was modeled with the HEC-1DB computer program. The HEC-1DB computer program computes a PMF runoff hydrograph and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. The PMF inflow to Curtis Reservoir was routed through the dam. Identical methods were used for various percentages of the PMF.

(3) Summary of Results. Pertinent results are tabularized at the end of Appendix C. The analysis reveals that, with the existing top elevation of 1497.8, Curtis Dam can pass about 17 percent of the PMF without overtopping. If the dam were raised to its design elevation of 1499.8 the spillway could pass 46 percent of the PMF.

(4) Spillway Adequacy. The criteria for rating a spillway is presented in Appendix C. The dike at Curtis Dam would be overtopped by 1.69 feet during the 1/2 PMF. This would be an erosion hazard at the downstream toe of the embankment. The embankment was assumed to fail over a 20-foot long breach 0.3 hour after the dike would be overtopped by 0.2 foot. The breach was assumed to extend down to Elevation 1454.3. A breach of this size will result in a peak outflow of 55,300 cfs. This flow was routed into Elmhurst Reservoir. Elmhurst Dam would not be overtopped by the failure of

Curtis Dam, assuming that no other inflow occurs to Elmhurst Dam (Appendix C). However, it would raise the pool level in Elmhurst Reservoir by 5.6 feet, or to within 3.4 feet of the top of Elmhurst Dam. For the occurrence of the 1/2 PMF over the Curtis watershed, it can be assumed that a major storm would be occurring over the entire Elmhurst watershed, which is about 37 square miles. As such, there is the probability that the combination of the uncontrolled runoff into Elmhurst Reservoir and the inflow from the dam break at Curtis Dam would overtop Elmhurst Dam and cause its failure. This would result in loss of life. The spillway capacity of Curtis Dam is rated as seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Curtis Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. Brush on the embankment slopes and at the toe of the floodwall is undesirable. The swell on the upstream slope is believed to be caused by uneven grading during construction. If this is not the cause, it would be of concern. Trail bike ruts damage the embankment and create an erosion potential. The two areas with grass missing could have been wet areas. Because the pool was over 20 feet below the spillway crest elevation, no definitive conclusions concerning the seepage potential of the two areas noted above or the dam in general could be made during the visual inspection. The cause of the embankment slopes being flatter than the slopes shown on Plate 4 is unknown; this is not considered a deficiency. The low areas on the top of the embankment are probably caused by settlement, except for the low area near the intake structure, which is evaluated in Section 5.

(3) Appurtenant Structures. The capstone on the approach wall to the intake structure was probably dislodged by ice floes.

The conditions in the spillway, auxiliary spillway and their associated channels are mostly caused by lack of maintenance. The design of the spillway left training wall is addressed hereafter. The possible slope movement behind this wall is undoubtedly caused by the failure of the wall. Movement of this slope is not an immediate hazard to the dam. It may eventually encroach upon the spillway channel. It might also present a hazard to the bridge at the

downstream end of the channel. During the periodic inspections by the Commonwealth and during a brief visit made the previous year for the Phase I National Dam Inspection Report for Elmhurst Dam, leakage was reported through the masonry spillway and auxiliary spillway joints. As noted previously, because of the low pool elevation on the day of the inspection, definitive conclusions concerning seepage could not be made.

The leaching on the spillway right training wall is not of immediate concern. As the capstones on this wall retain the embankment, their deteriorated condition is of concern.

The capstone on the floodwall was probably moved by the lateral earth pressure of the earthfill behind the wall. The slopes of the dike appeared quite steep in some areas. These steep slopes are probably the cause of the sloughing, which is only of shallow depth on the landward side of the dike. Overall, the dike and floodwall do not appear to be well maintained.

b. Design and Construction Data. No stability analysis for the embankment is available for review. In their 1914 report, the Pennsylvania Water Supply Commission analyzed the structural stability of the spillway section. For this analysis, the tailwater was assumed to be at the toe of the structure and uplift was assumed to vary from zero at the toe to 2/3 the full hydrostatic head at the heel. Full hydrostatic pressure was used on the upstream face. For these loading conditions, the resultant is within the middle third and both the toe pressure and the factor of safety against sliding are within acceptable limits.

For this study three stability analyses were performed. The masonry gravity spillway section was analyzed assuming tailwater 4.3 feet above the toe, the pool at the top of the dam, and uplift varying from full tailwater at the toe to full tailwater plus 2/3 the difference between headwater and tailwater at the heel. Only the highest section was analyzed and the stability was checked at its base. For this loading condition, the resultant is within the middle third,

about 10.4 feet from the toe; the factor of safety against sliding and the toe pressure are adequate. The OCE guideline states that the resultant should be within the middle third; the structure is apparently stable for this loading condition.

The stability of the masonry gravity auxiliary spillway section was also analyzed for this study. Only the highest section was considered and the stability was checked at its base. The loading conditions were identical to the spillway section above, except tailwater was assumed to be 2.9 feet above the toe. For this loading condition the resultant is within the middle third, about 5.7 feet from the toe; the factor of safety against sliding and the toe pressure are adequate. The structure is apparently stable for this loading condition.

The spillway left training wall was also analyzed for this study to aid in determining the cause of its failure. The loading conditions were similar to the other sections analyzed except it was assumed that there was no tailwater. The water level on the landward side of the wall was assumed at the top of the wall; at-rest earth pressure was assumed against the landward face. For these loading conditions, the resultant is outside the base, about 3.0 feet from the toe. The design of the wall is obviously inadequate, although the lack of maintenance has not helped the stability of the structure.

c. Operating Records. There are no formal records of operation. No evidence of instability on any feature of the dam has been noted, except for the failure of the spillway left training wall.

d. Post-construction Changes. As noted herein, there is sufficient information available on all modifications made to Curtis Dam, such that its stability can be assessed.

e. Seismic Stability. Curtis Dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there are no formal static stability analyses, and there is the potential of earthquake forces moving or cracking the masonry core-wall, the theoretical seismic stability of Curtis Dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Curtis Dam is judged to be in fair condition. The spillway will pass only 17 percent of the PMF without overtopping of the dam. If the dam should fail, the resulting outflows would probably overtop and cause the failure of the high hazard Elmhurst Dam downstream. This would result in a loss of life. The spillway capacity is rated as seriously inadequate. According to criteria established for these studies, the dam must be rated as unsafe, nonemergency, because the spillway capacity is seriously inadequate.

If the embankment and dike were raised to their design elevation, the spillway could pass 46 percent of the PMF. The spillway capacity would still be rated as seriously inadequate.

(2) There is no evidence of stability problems on the embankment. The spillway and auxiliary spillway sections meet the OCE guidelines for stability. A length of the left spillway training wall has failed.

(3) A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies
Embankment:	
Upstream slope	Swelled, riprap does not extend to the top of the dam, brush.
Top	Low areas.
Downstream right abutment	Possible wet areas, trail bike ruts.

Features and Location	Observed Deficiencies
Outlet Works:	
Valve pit	Not drained.
Approach wall	Dislodged capstone.
Spillway (Main and Auxiliary):	
Weirs	Deteriorated mortar.
Channels	Wall failure, deteriorated mortar and concrete.
Right training wall	Deteriorating capstones.
Downstream end	Scour hole beneath bridge.
Floodwall and Dike:	
Floodwall	Shifted capstone.
Dike	Sloughing, apparent washout, low areas.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform a study to more accurately ascertain the spillway capacity required for Curtis Dam as well as the nature and extent of the mitigation measures required to make the spillway hydraulically adequate. Take appropriate action as required. The studies should be performed by a professional engineer experienced in the design and construction of dams.

(2) Raise the embankment and the earthfill at the dike and floodwall to the design elevation.

(3) Perform a study to ascertain the remedial measures required at the spillway area to correct deficiencies. This study should address the deteriorated mortar and concrete at the spillway, auxiliary spillway, auxiliary spillway apron, and spillway channel. The study should also address the structural stability of the left training wall, the hydraulic adequacy of the auxiliary spillway apron, and the scour potential beneath the downstream bridge. Take appropriate action as required. The section of wall lying in the spillway channel should be removed immediately. The study should be performed by a professional engineer, as noted above.

(4) With the reservoir at the normal pool level, inspect the embankment, dike, and floodwall for wet areas and seepage. Take appropriate action as required.

(5) Perform a study to ascertain the structural adequacy of the floodwall and dike. Take appropriate action as required. The study should be performed by a professional engineer as noted above.

(6) Repair the capstones on the spillway right training wall and the outlet works approach wall.

(7) Monitor by any suitable means the swell on the upstream slope of the embankment. If changes are noted, take immediate remedial action.

(8) Extend the riprap to the top of the dam.

(9) Provide a drain in the valve pit.

(10) Remove brush from the downstream toe of the floodwall and dike, as well as on the upstream slope of the embankment.

b. In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Curtis Dam.

(2) Develop impediments to trail bike use on or near the dam.

(3) During periods of unusually heavy rains, provide round-the-clock surveillance of Curtis Dam.

(4) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

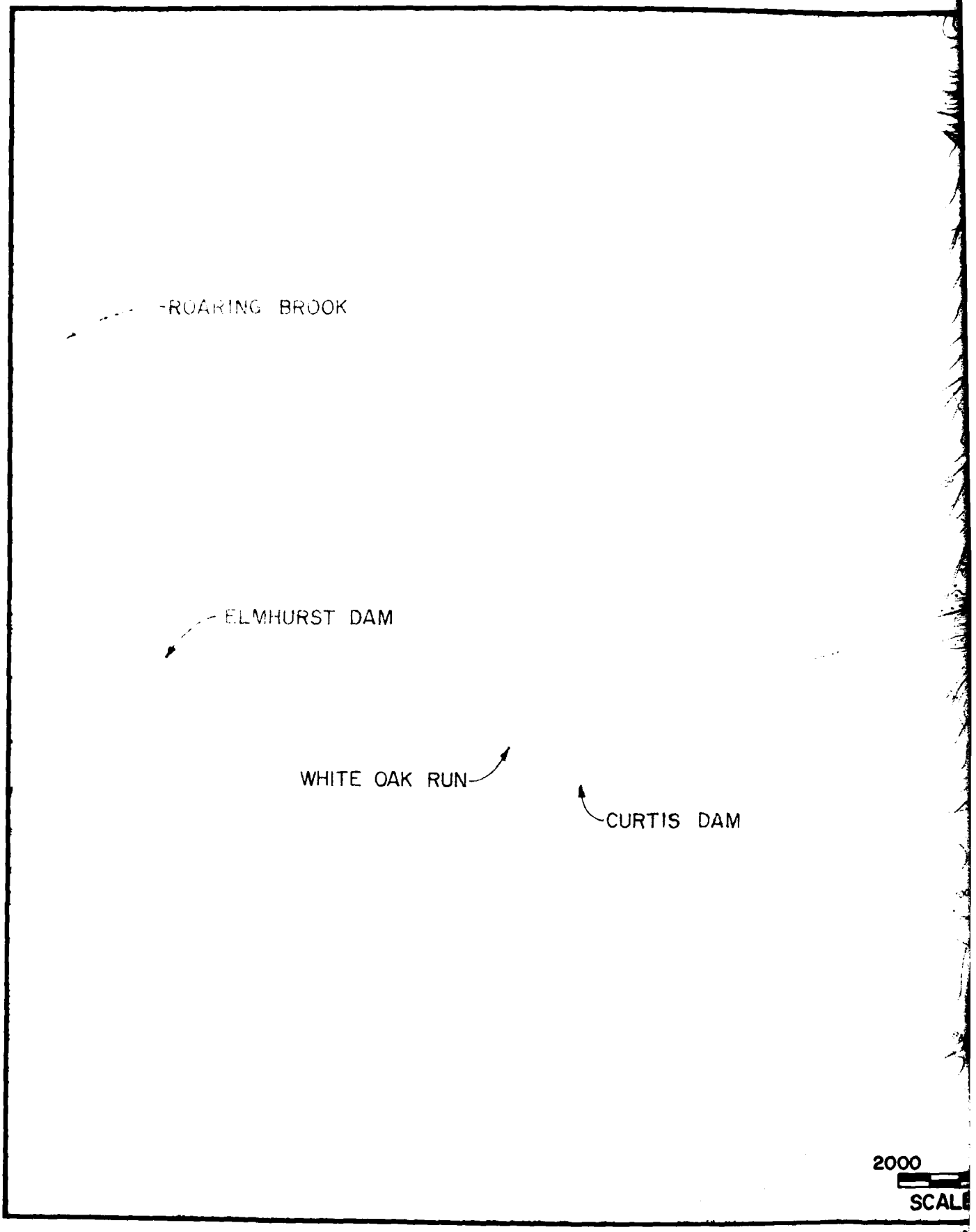
PENNSYLVANIA GAS AND WATER COMPANY

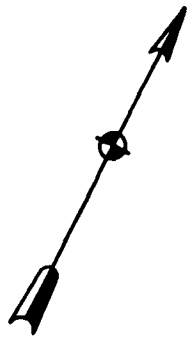
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

PLATES


ROARING BROOK
ELMHURST DAM
WHITE OAK RUN
CURTIS DAM
2000
SCALE



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

CURTIS DAM

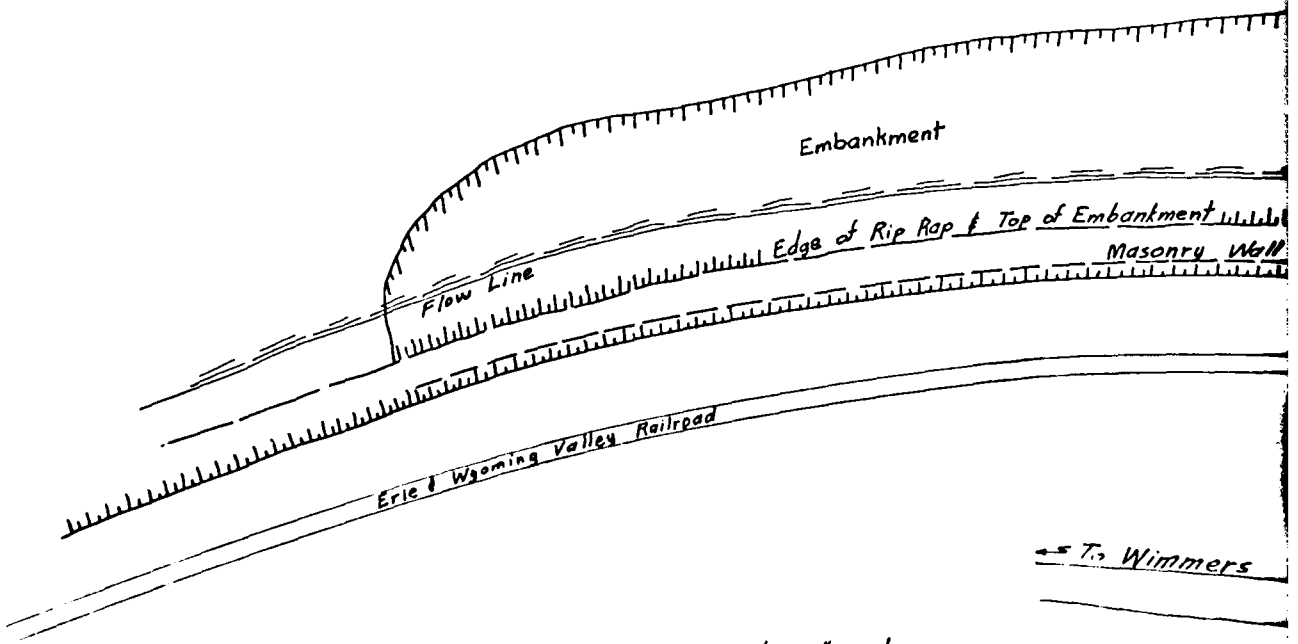
PENNSYLVANIA GAS AND WATER COMPANY

LOCATION MAP

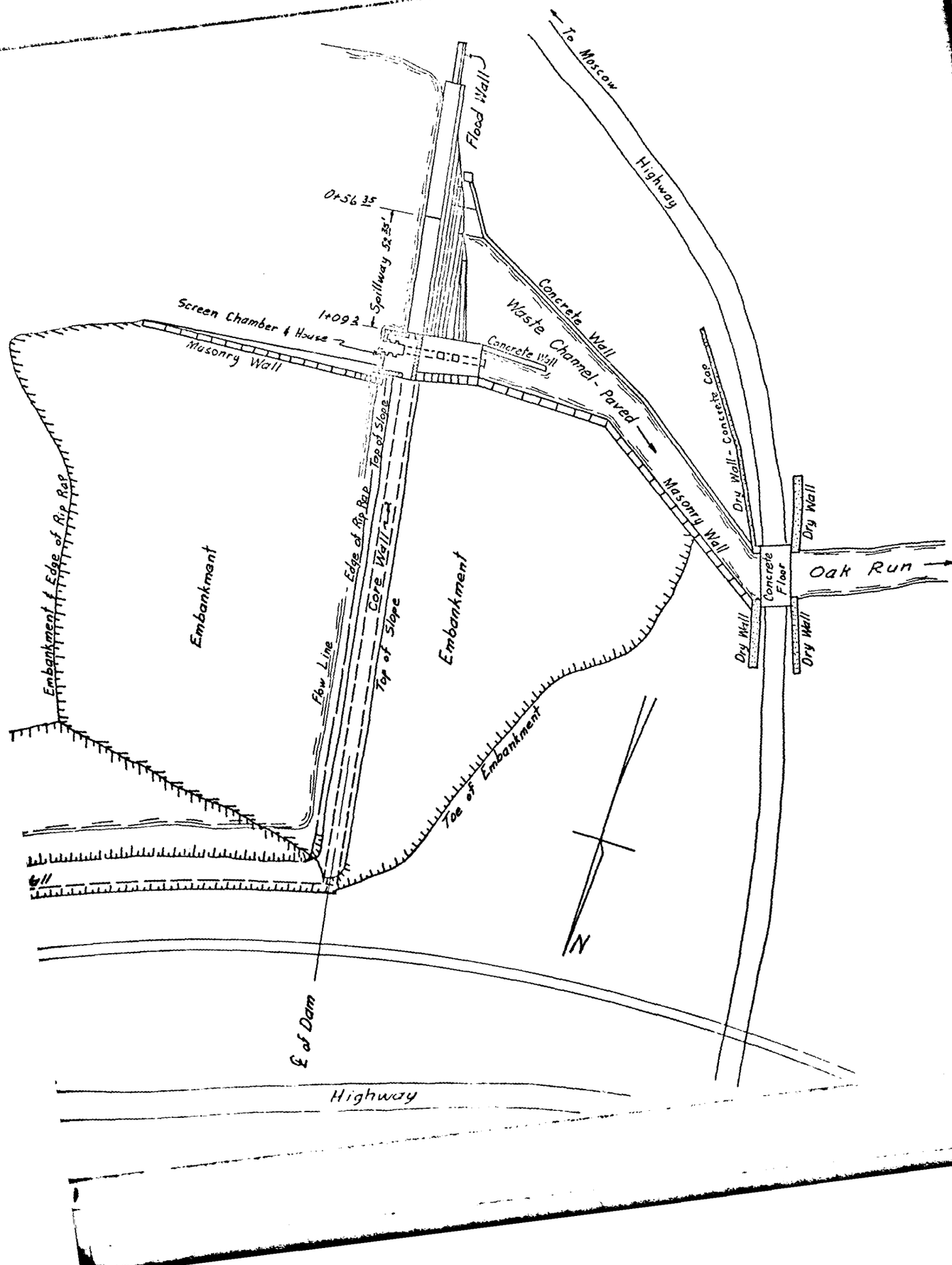
APRIL 1979 PLATE 1

0 2000

E: 1 IN. = 2000 FT.


Embankment
Flow Line
Edge of Rip Rap & Top of Embankment
Masonry Wall
Erie & Wyoming Valley Railroad
To Wimmers

Scale: 1" = 50'


To Moscow
Highway
Flood Wall
0+56 35
Spillway 52.35'
1+09 3
Screen Chamber & House
Masonry Wall
Concrete Wall
Waste Channel - Paved
Concrete Wall
Dry Wall - Concrete Cap
Masonry Wall
Dry Wall
Concrete Floor
Oak Run
Dry Wall
Dry Wall
Embankment
Embankment
Embankment & Edge of Rip Rap
Edge of Rip Rap
Top of Slope
Core Wall
Flow Line
Top of Slope
Toe of Embankment
N
℄ of Dam
Highway

OTE:
This drawing was traced from
ner's original drawing.

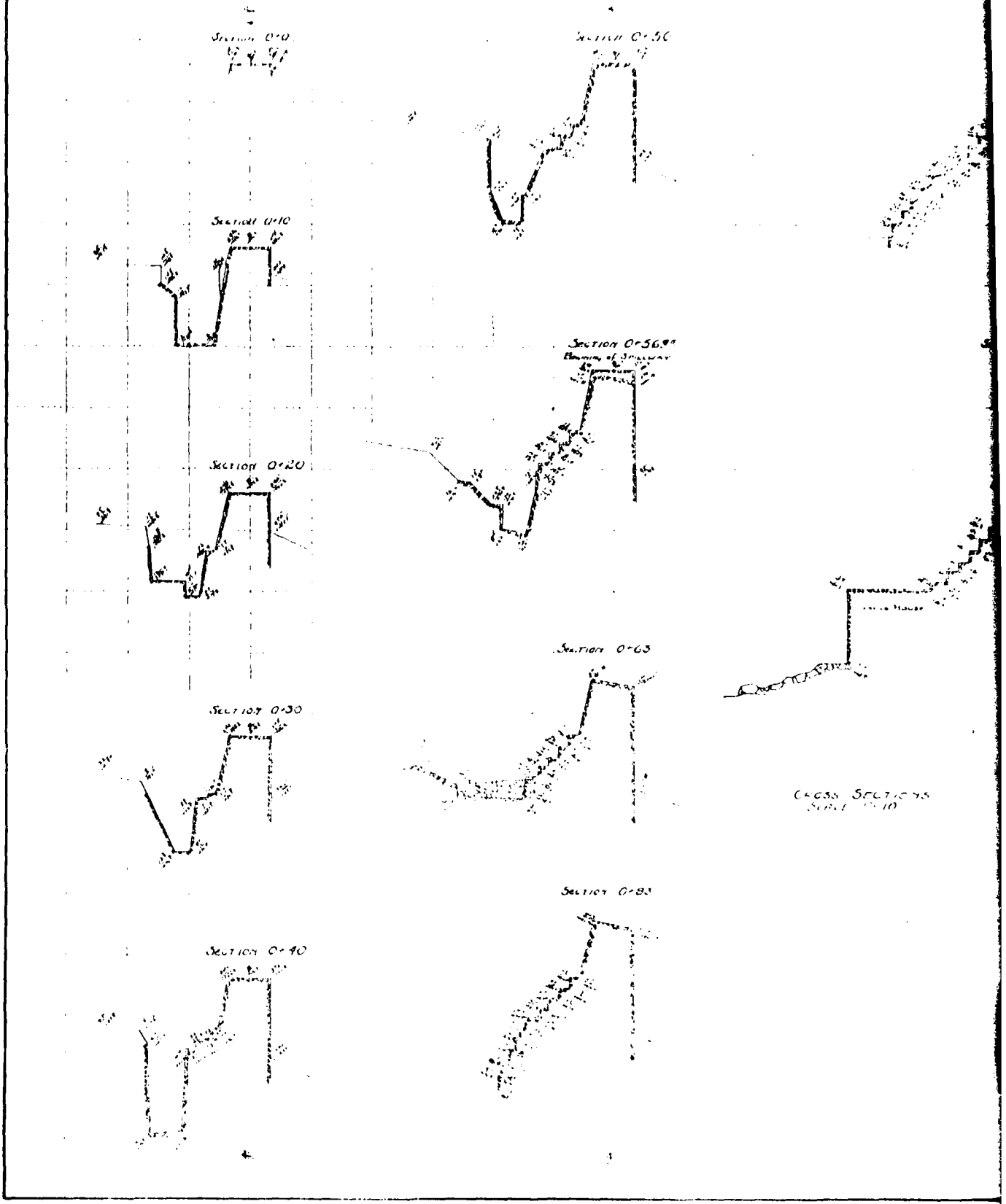
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

CURTIS DAM

PENNSYLVANIA GAS AND WATER COMPANY

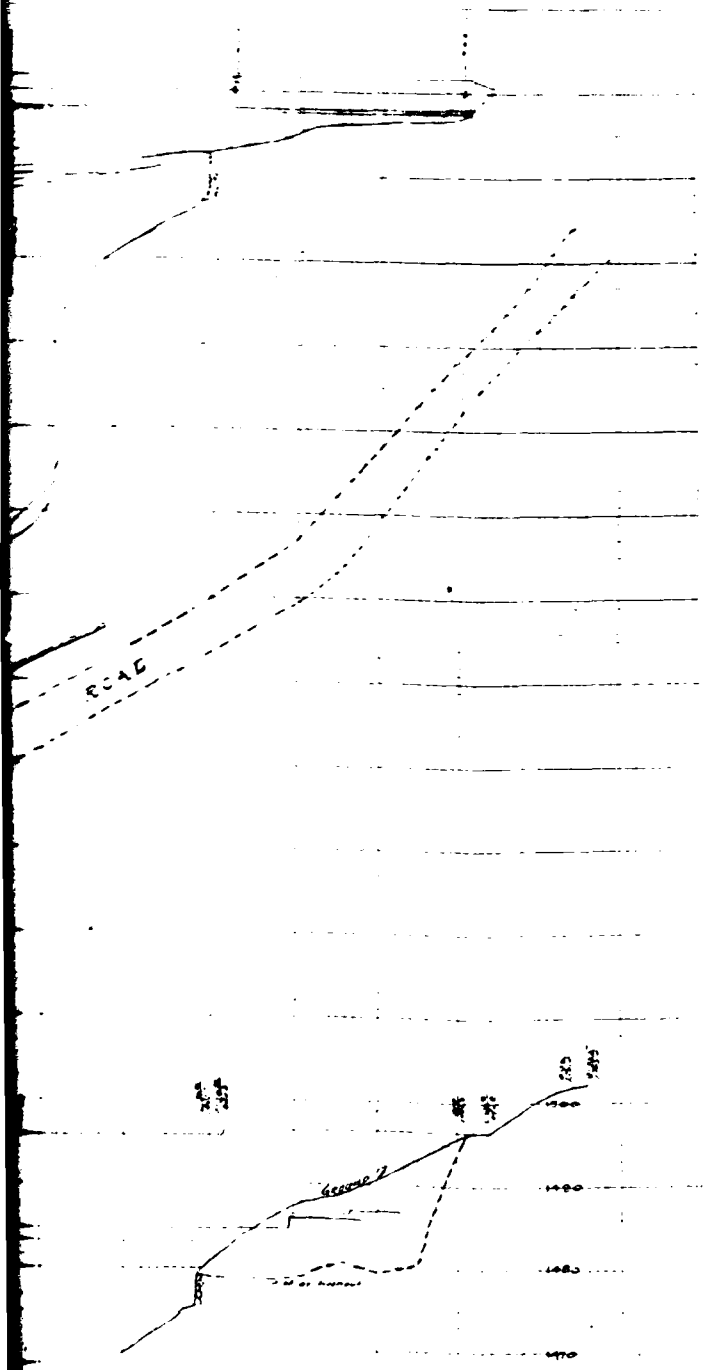
PLAN

APRIL 1979 PLATE 2


Section 0+10
Section 0+30
Section 0+10
Section 0+56.99
Section 0+20
Section 0+63
Section 0+30
Cross Section
Section 0+83
Section 0+40

PLAN
SCALE 1"=20'
PLAN, ELEVATION & SECTIONS
OF
CURTIS DAM
THE S.,G.& W. Co.
FRONT ELEVATION
SCALES HORZ. 1"=20'
VERT. 1"=10'

2



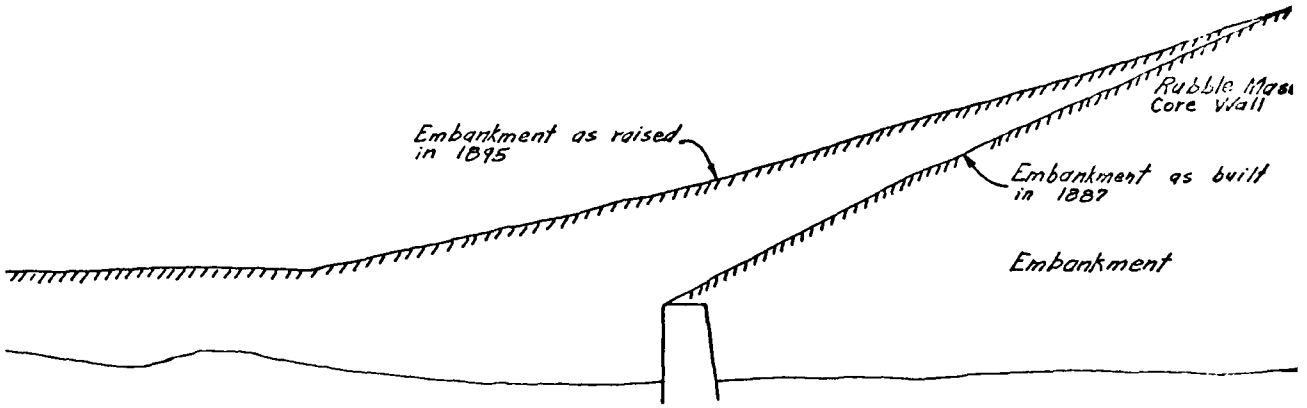
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

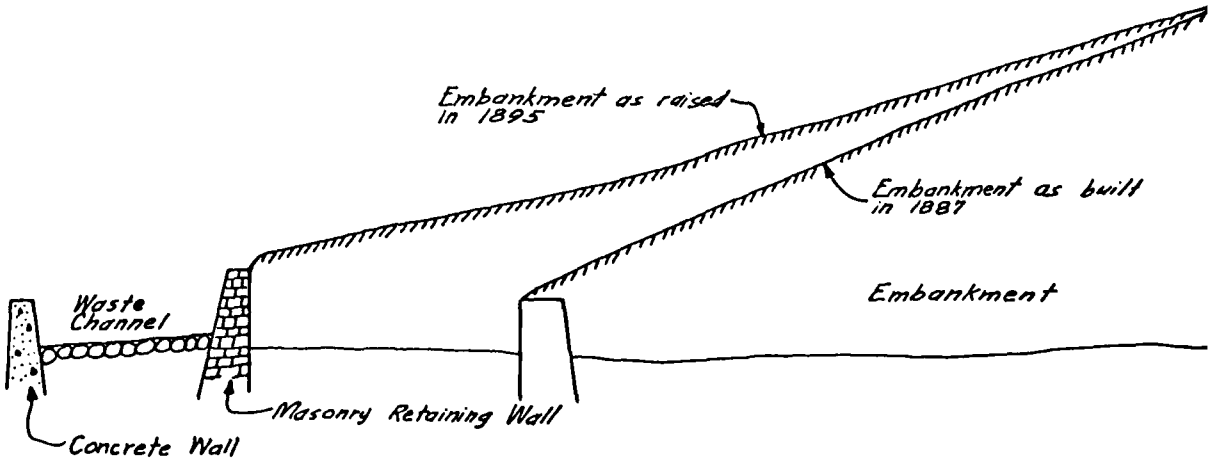
CURTIS DAM

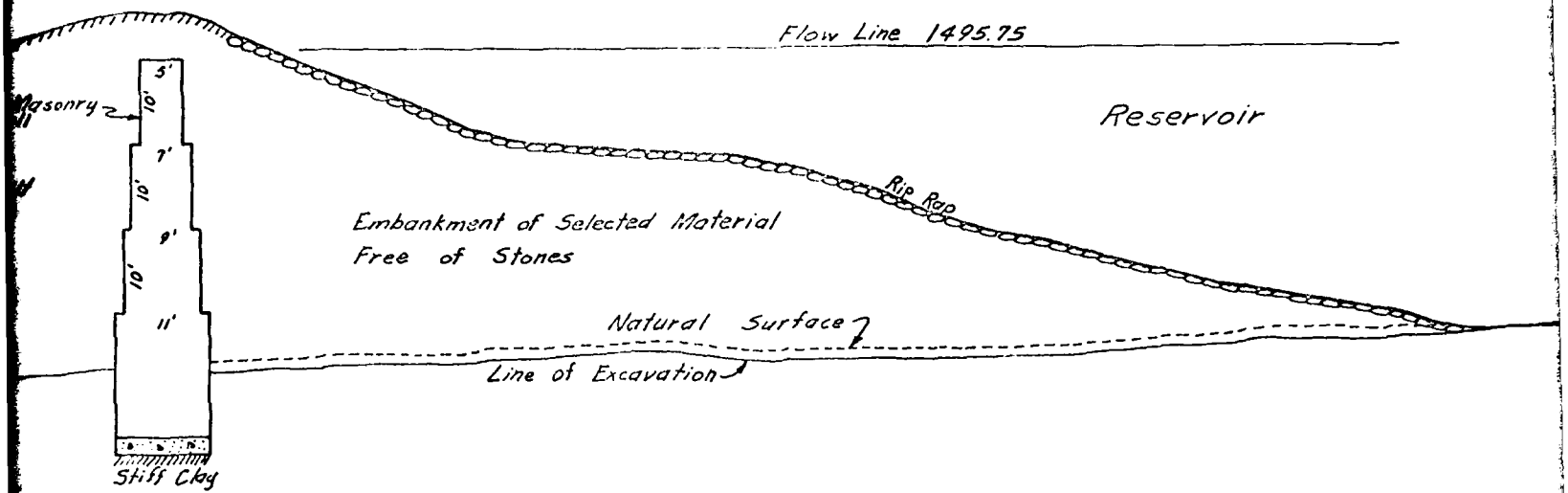
PENNSYLVANIA GAS AND WATER COMPANY

PLAN, PROFILE, AND
SPILLWAY SECTIONS

APRIL 1979 PLATE 3

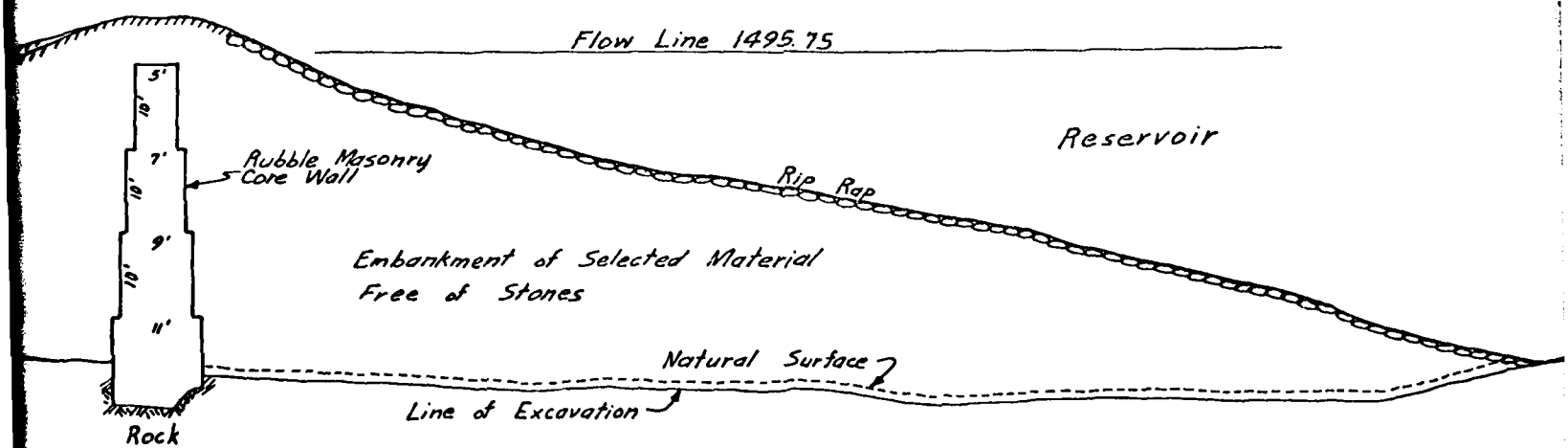

Embankment as raised in 1895
Rubble Mas
Core Wall
Embankment as built in 1887
Embankment


Embankment as raised in 1895
Embankment as built in 1887
Waste Channel
Embankment
Masonry Retaining Wall
Concrete Wall



SEC. 2+25

Scale: 1" = 20'

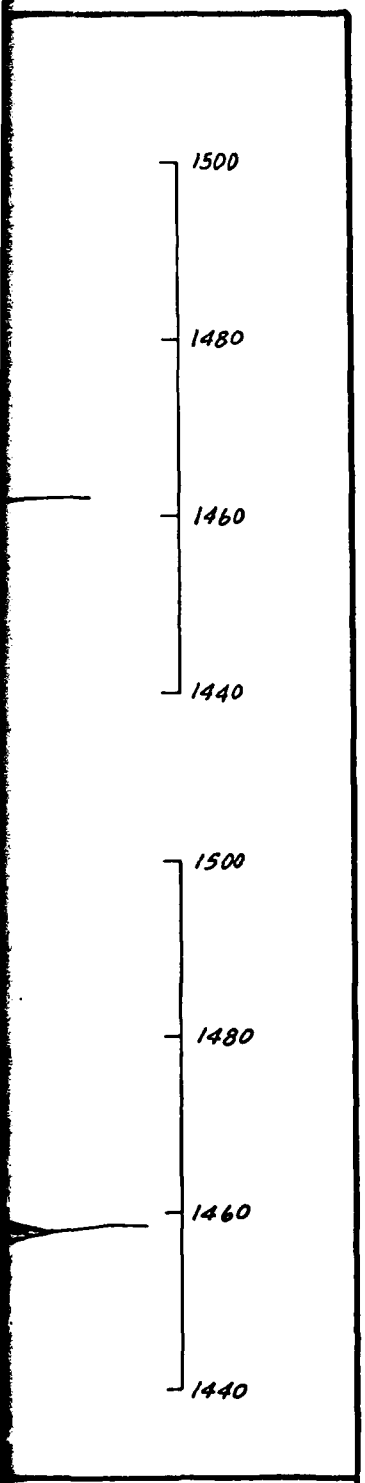


SEC. 1+60

Scale: 1" = 20'

NOTE:
This drawing was traced from owner's original drawing.

PHASE I IN
NATIONAL DAM
CUR
PENNSYLVANIA GA
EMBANKME
APRIL 1979



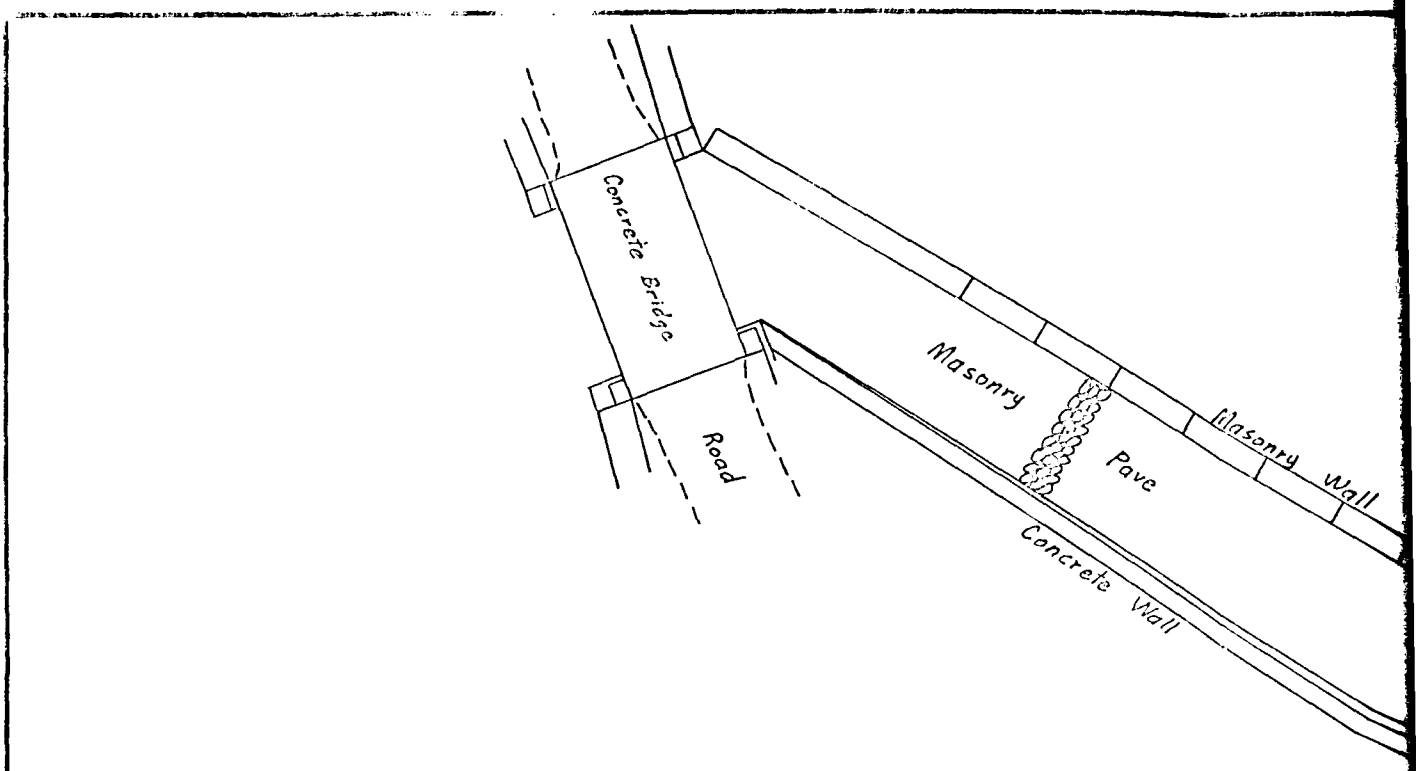
I INSPECTION REPORT
DAM INSPECTION PROGRAM

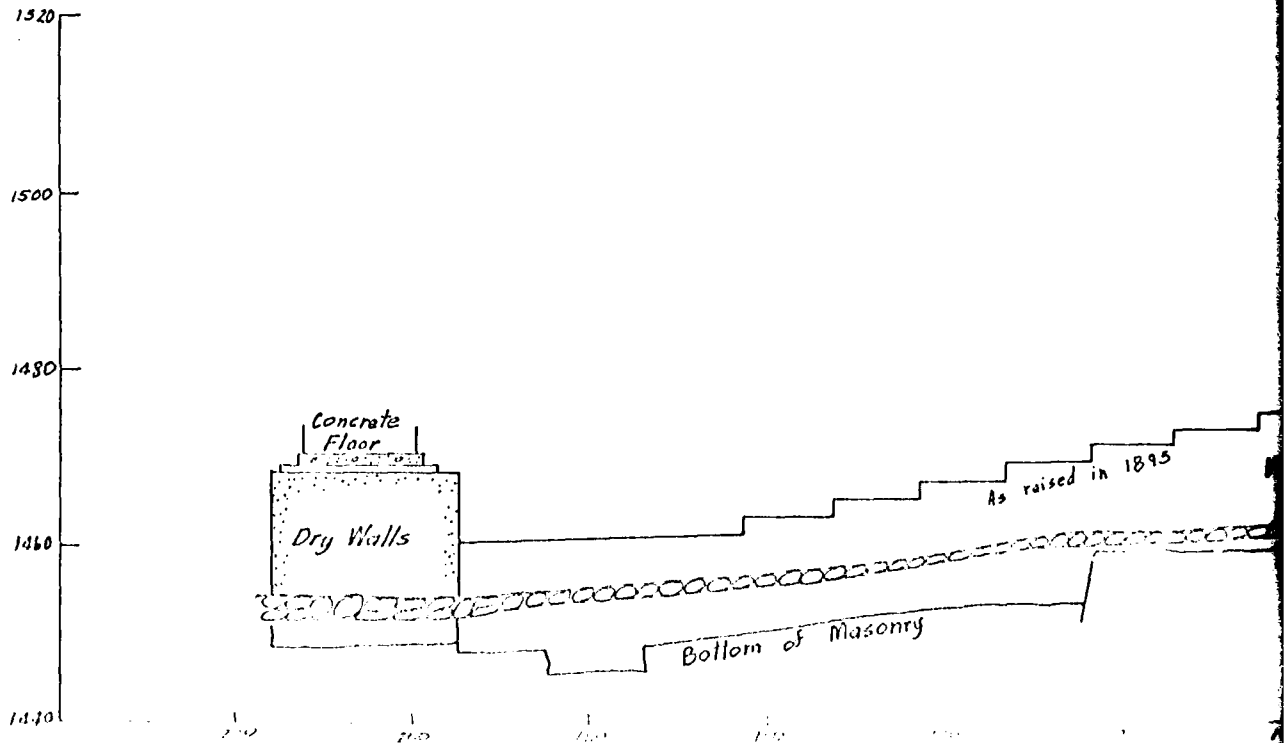
CURTIS DAM

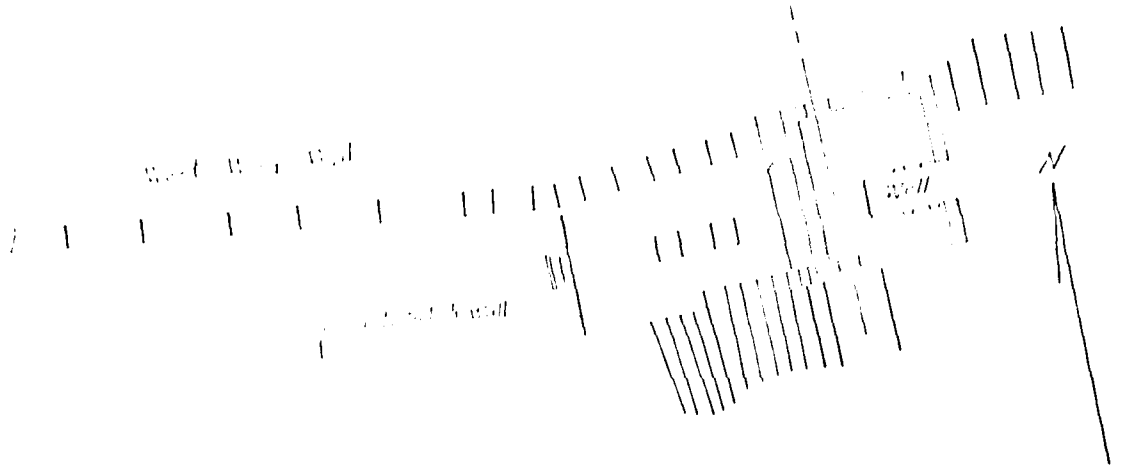
A GAS AND WATER COMPANY

KMENT SECTIONS

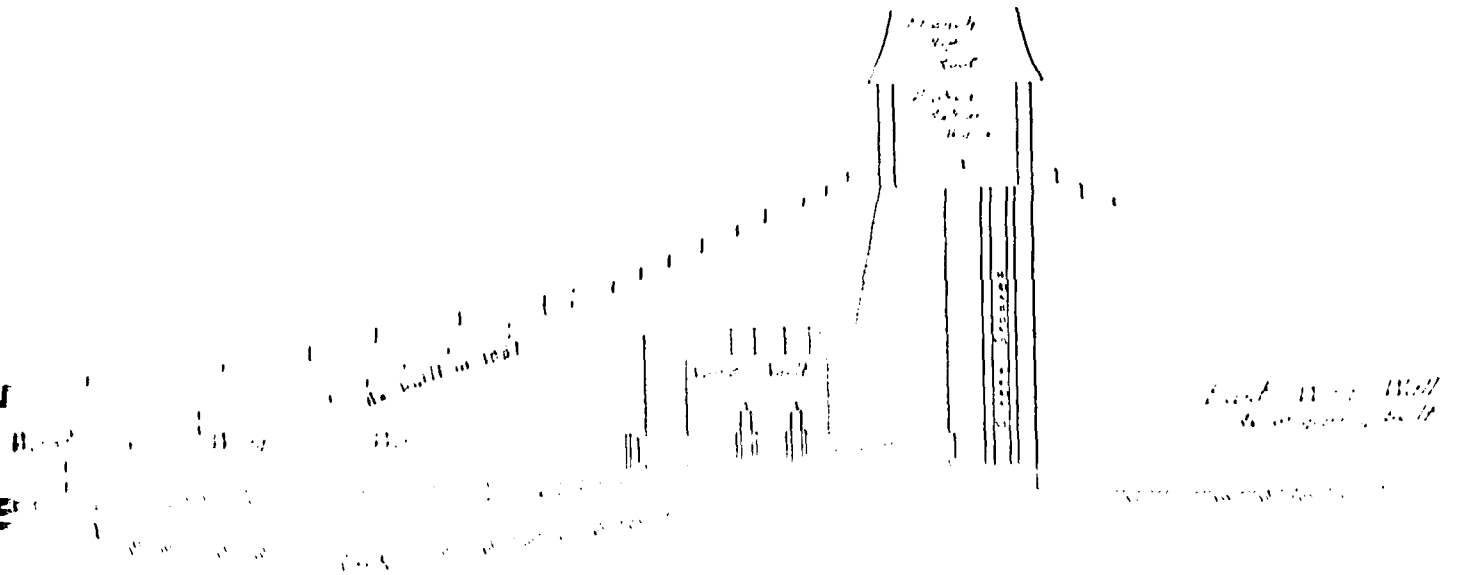
PLATE 4

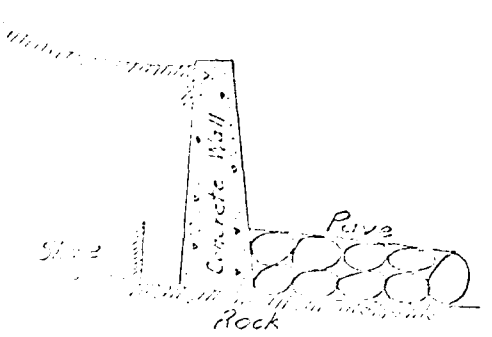

Concrete Bridge
Road
Masonry
Pave
Masonry Wall
Concrete Wall


1520
1500
1480
1460
1440
Concrete Floor
Dry Walls
As raised in 1895
Bottom of Masonry

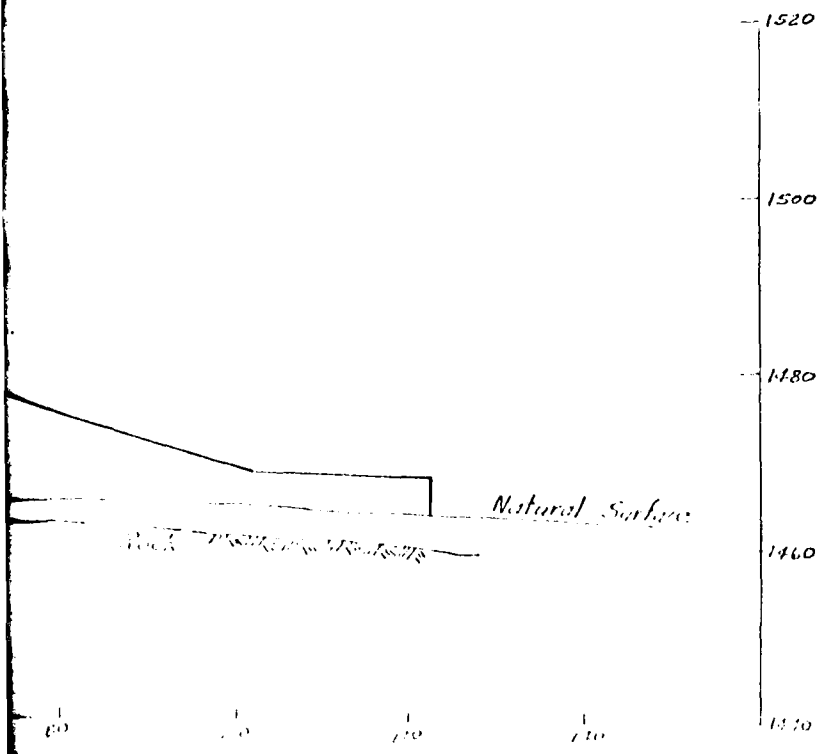


PLAN





LEFT WALL SECTION
Scale: 1" = 10'



NOTE
This drawing was traced from owner's original drawing.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
CURTIS DAM
PENNSYLVANIA GAS AND WATER COMPANY
SPILLWAY OUTLET CHANNEL
APRIL 1979 PLATE 5

3

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: CURTIS

NDI ID NO.: PA - 00370 DER ID NO.: 35-17

ITEM	REMARKS
AS-BUILT DRAWINGS	SOME DESIGN DRAWINGS AVAILABLE. NO AS-BUILT DRAWINGS
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	BUILT 1886-1887 SPILLWAY RAISED - 1899 AUXILIARY SPILLWAY CHANNEL CONSTRUCTED, EMBANKMENT RAISED TO UNIFORM ELEVATION, AND LEFT ABUTMENT CONSTRUCTED. - 1914
TYPICAL SECTIONS OF DAM	SEE PLATE 4
OUTLETS: Plan Details Constraints Discharge Ratings	SEE PLATE 2 AND APPENDIX C

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	1914 PENNSYLVANIA WATER SUPPLY COMMISSION REPORT.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	1914 PENNSYLVANIA WATER SUPPLY COMMISSION REPORT.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	FOR THE VARIOUS MODIFICATIONS ONLY

ENGINEERING DATA

Sheet 3 of 4

ITEM	REMARKS
BORROW SOURCES	RESERVOIR
MONITORING SYSTEMS	NONE
MODIFICATIONS	SEE CONSTRUCTION HISTORY
HIGH POOL RECORDS	NO SYSTEMATIC RECORDS.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	OVERTOPPED BY 1.0 FOOT JULY 1914 - EROSION AT TOE OF SPILLWAY OCCURRED. OVERTOPPING WAS BY SOUTH ABUTMENT AND NOT ON THE EMBANKMENT.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NOT AVAILABLE.
SPILLWAY: Plan Sections Details	SEE PLATES 2, 3 AND 5
OPERATING EQUIPMENT: Plans Details	SEE PLATE 2
PREVIOUS INSPECTIONS Dates Deficiencies	1916 - NOTED SATISFACTORY COMPLETION OF REPAIRS 1921 - LOW AREA NEAR GATE HOUSE. LEFT OF SPILLWAY, LEAKAGE UNDER COPING. SEEPAGE ALONG FLOODWAY SPILLWAY RIGHT TRAINING WALL, AND AT GATEHOUSE. 1924 - PER 1921 PLUS CONCRETE DISINTEGRATION ALONG LEFT TRAINING WALL. SPILLWAY MASONRY NEEDS REPOINTING. 1928 - NOTED STORM OVERTOPPED THE AUXILIARY SPILLWAY AND THAT OWNER INTENDS TO EXTEND THE AUXILIARY SPILLWAY CHANNEL 1930 - NOTED CONSTRUCTION OF AUXILIARY SPILLWAY CHANNEL.

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED)	1933 - SEEPAGE THROUGH SPILLWAY JOINTS AND RIGHT ABUTMENT, SEEPAGE ALONG [illegible] FLOODWALL. 1941 - SEEPAGE AT LEAKAGE THROUGH
	SPILLWAY JOINTS. DISINTEGRATION GUNITE AT AUX. SPILLWAY CHANNEL, SEEPAGE AT THIS POINT. 1943 - LEAKAGE AT BLOW-OFF, DOWNSTREAM FACE OF MASONRY HAD JUST
	BEEN REPOINTED. GUNITE, PER 1941. 1945 - GUNITE - PER 1941. LEAKAGE IN LOWER COURSES OF SPILLWAY MASONRY. 1953 - LEFT TRAINING WALL DETERIORATING.
	1957 - LEAKAGE THROUGH SPILLWAY RIGHT SIDE. LEFT TRAINING WALL IS DETERIORATED AND FALLEN THROUGH. 1965 - NO DEFICIENCIES.

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: CURTIS County: LACKAWANNA State: PENNSYLVANIA

NDI ID No.: PA-00370 DER ID No.: 35-17

Type of Dam: EARTHFILL W/MASONRY CORE-WALL Hazard Category: HIGH

Date(s) Inspection: 7 NOVEMBER 1978 Weather: RAIN Temperature: 55°F

SOIL CONDITIONS: MOIST

Pool Elevation at Time of Inspection: 1475.2 msl/Tailwater at Time of Inspection: 1454.3 msl

Inspection Personnel:

J. CROUSE (GFCC)

G. SMITH (GFCC)

R. GLOCKNER (PGW)

A. WHITMAN (GFCC) Recorder

B-1

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	UPSTREAM SLOPE IS UNEVEN.	10' ABOVE POOL EL. SLOPE IS SWELLED OVER AN AREA 40'x20'
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	TRAIL BIKE RUTS AT RIGHT ABUTMENT.	
CREST ALIGNMENT: Vertical Horizontal	SEE SURVEY DATA FOLLOWING INSPECTION FORMS.	
RIPRAP FAILURES	GOOD CONDITION. RIPRAP TERMINATES BELOW TOP OF DAM.	SEE SURVEY DATA

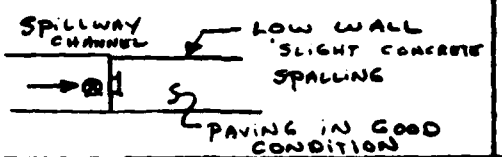
EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	SEE SEEPAGE below	
ANY NOTICEABLE SEEPAGE		POSSIBLE WET AREAS NOTED AT LEFT
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	
BRUSH	MINOR AMOUNT UPSTREAM SLOPE ABOVE SPILLWAY CREST DOWNSTREAM SLOPE AT RAILROAD FLOODWALL	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	36" CIP	
INTAKE STRUCTURE	APPROACH WALL - MOVED CAPSTONE	HOLE IN ROOF - NOT A HAZARD TO THE DAM.
OUTLET STRUCTURE	WATER IN VALVE PIT - NO APPARENT DRAIN	
OUTLET CHANNEL		
EMERGENCY GATE	OPENED 5% by 2 MEN IN 10 MINUTES - NO PROBLEMS.	ACCESS DURING VERY LARGE FLOODS MAY BE HAZARDOUS.

UNGATED SPILLWAY

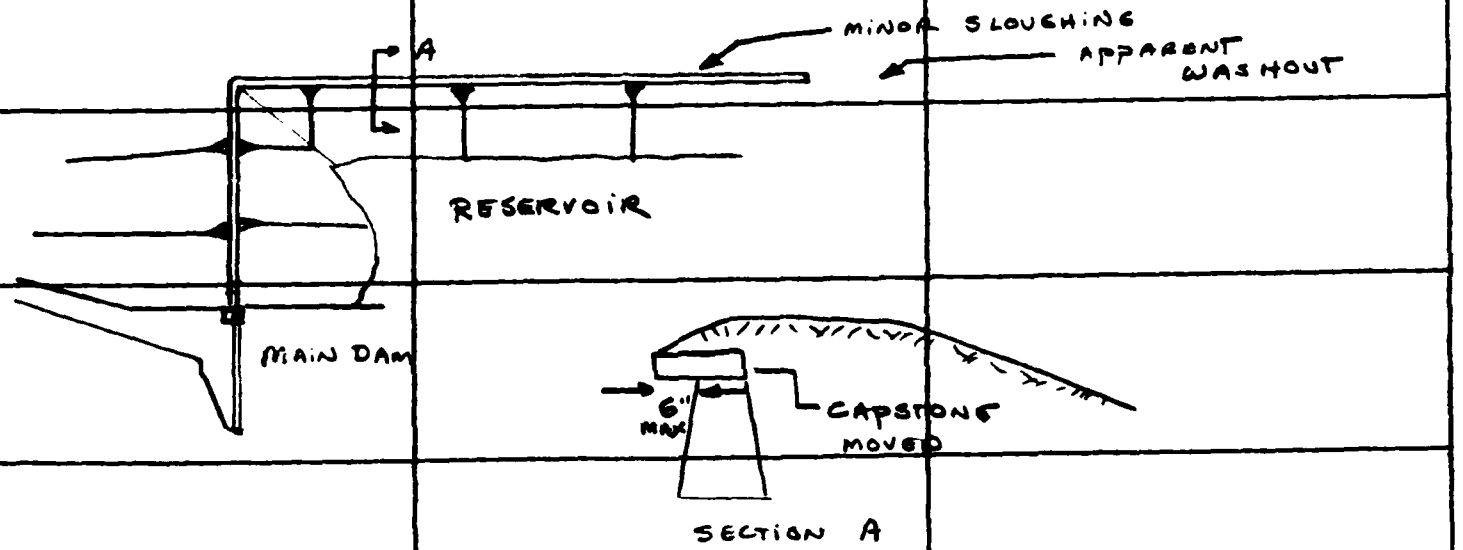
Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MASONRY ~~CONCRETE~~ WEIR	MORTAR DETERIORATED ON AUXILIARY SPILLWAY FROM CREST TO 2' BELOW CREST ON UPSTREAM SIDE.	ALSO SEE below.
APPROACH CHANNEL	RESERVOIR	LEFT SHORE HAS A DRY MASONRY WALL, 6' HIGH - NO DEFICIENCIES
DISCHARGE CHANNEL	A A MORTAR DETERIORATED	4' 3' 2.9' Aux. Spillway Crest 1.9 1.0 SECTION A
BRIDGE AND PIERS	CONCRETE COVER (GUNITE) ALMOST COMPLETELY ERODED. SEVERE CONCRETE SCOUR ALONG MOST OF WALL, SEVERE SCOUR AT BOTTOM, SPALLING AND PATTERN CRACKING MORTAR MISSING TILTED 9' LONG SECTION LYING ON SIDE 9' LONG SECTION OFFSET CAPSTONES DETERIORATING LEACHING AT LOWER PART OF WALL 1.5 DEEP X 10' LONG SCOUR 0.5 gpm CLEAR SEEPAGE
MORTAR IS 95% ERODED IN BOTTOM OF CHANNEL		

B-5

RAILROAD FLOODWALL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS



INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE	
WEIRS	NONE	
PIEZOMETERS	NONE	
OTHER	NONE	

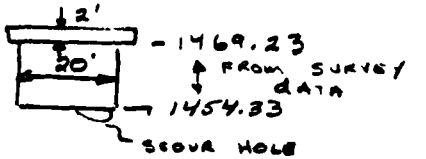
RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	FAIRLY STEEP	
SEDIMENTATION	NO REPORTED OR OBSERVED PROBLEMS	
WATERSHED DESCRIPTION	MOSTLY WOODED MINOR DEVELOPMENT.	

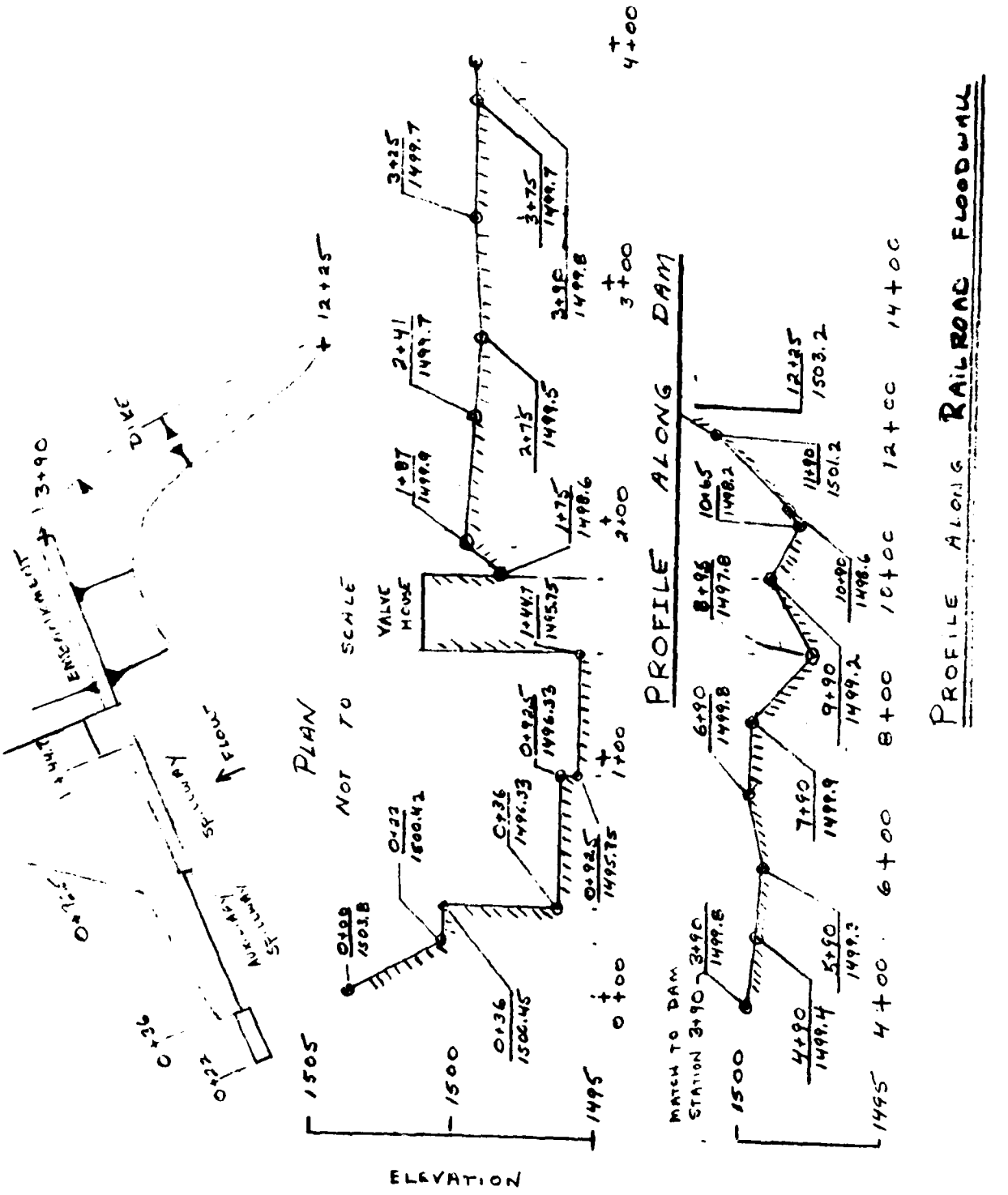
DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	BRIDGE AT DOWNSTREAM END OF SPILLWAY CHANNEL.	
SLOPES	RELATIVELY FLAT	
APPROXIMATE NUMBER OF HOMES AND POPULATION	NO HOUSES BRIDGE AT END SPILLWAY CHANNEL ABANDONED BRIDGE ELMHURST RESERVOIR	

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Curves — FILE NO.
SHEET NO. ____ OF ____ SHEETS
FOR
COMPUTED BY ____ DATE ____ CHECKED BY ____ DATE ____



B-10

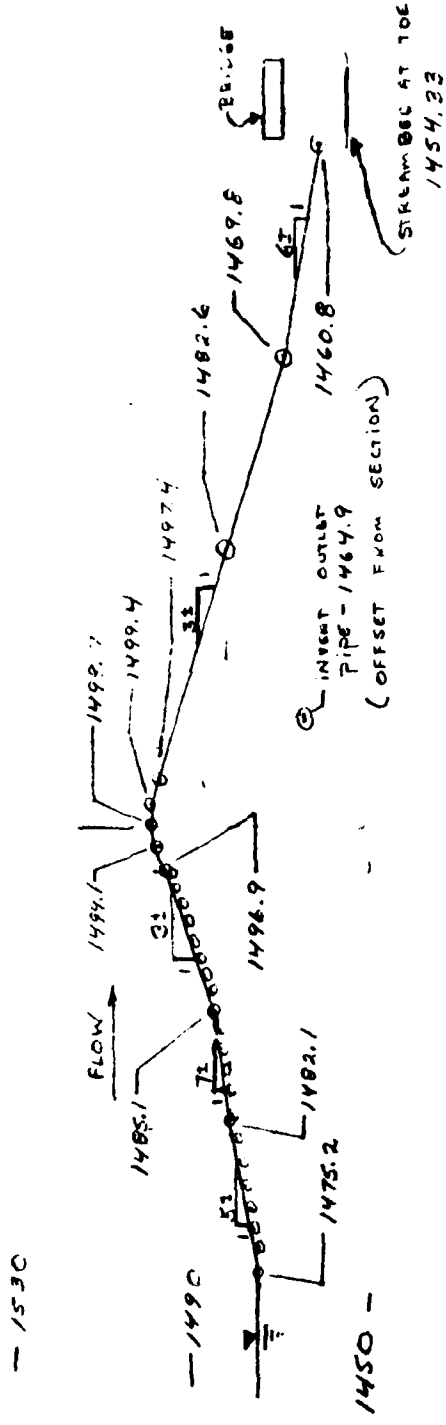
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____

_____ SHEET NO. _____ OF _____ SHEETS

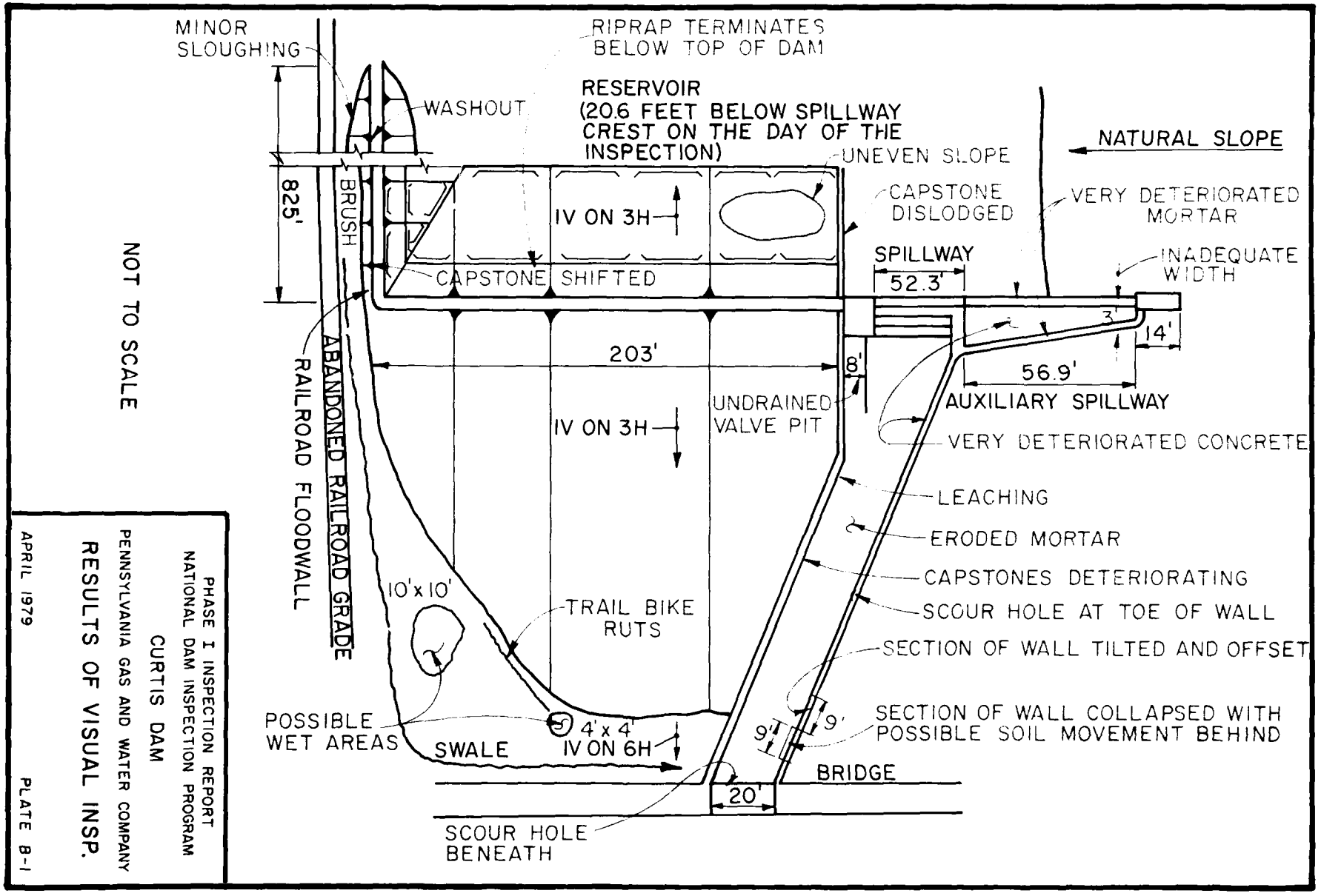
FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SECTION AT STATION 2+41
SCALE: 1" = 40'

B-11



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

CURTIS DAM

PENNSYLVANIA GAS AND WATER COMPANY

RESULTS OF VISUAL INSP.

APRIL 1979

PLATE B-1

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX C

HYDROLOGY AND HYDRAULICS

APPENDIX C

HYDROLOGY AND HYDRAULICS

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

APPENDIX C

SUSQUEHANNA River Basin

Name of Stream: WHITE OAK RUN

Name of Dam: CURTIS

NDI ID No.: PA-00370

DER ID No.: 35-17

Latitude: N 41° 22' 30" Longitude: W 75° 30' 50"

Top of Dam (~~low spot~~ DESIGN) Elevation: 1499.4

Streambed Elevation: 1454.3 Height of Dam: 45.1 ft

Reservoir Storage at Top of Dam Elevation: 1626 acre-ft

Size Category: INTERMEDIATE

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: PMF

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
NONE				

DOWNSTREAM DAMS

ELMHURST	1.4	64	3744	HIGH HAZARD
				INADEQUATE SPILLWAY
				NDI PA-00296

SUSQUEHANNA River Basin

Name of Stream: WHITE OAK RUN

Name of Dam: CURTIS

NDI ID No.: PA-00370

DER ID No.: 35-17

Latitude: N 41° 22' 30" Longitude: W 75° 30' 50"

DETERMINATION OF PMF RAINFALL

For Area A

which consists of Subareas A1 of 2.4 sq. mile

Total Drainage Area 2.4 sq. mile

PMF Rainfall Index = 22.15 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone	N/A	N/A
Geographic Adjustment Factor	96%	1.0
Revised Index Rainfall	21.3	N/A

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	118
12 hours	127
24 hours	136
48 hours	142
72 hours	145
96 hours	N/A

Data for Dam at Outlet of Subarea A1
(see Sketch on Sheet C-4)

Name of Dam: CURTIS Sheet 1 of __

Height: 45 ~~(existing)~~

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	1497.8	1499.8
Spillway Crest Elevation	1495.75	1495.75
Spillway Head Available (ft)	2.05	4.05
Type Spillway	BROAD CREST W/INCLINED TOP	
"C" Value - Spillway	3.1	3.1
Crest Length - Spillway (ft)	52.3	52.3
Spillway Peak Discharge (cfs)	476	1321
Auxiliary Spillway Crest Elevation	1496.3	1496.3
Auxiliary Spillway Head Available (ft)	1.5	3.5
Type Auxiliary Spillway	BROAD CRESTED WEIR	
"C" Value - Auxiliary Spillway	2.7	2.7
Crest Length - Auxiliary Spillway (ft)	56.85	56.85
Auxiliary Spillway Peak Discharge (cfs)	282	1005
Combined Spillway Discharge (cfs)	758 ≈ 780	2326 ≈ 2340 (ROUNDED TO AGREE WITH COMPUTER ANALYSIS OUTPUT)

Spillway Rating Curve:

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Q Combined (cfs)
1495.75 ≈ 1495.8	0	0	0
1496.3	66	0	66
1497.3	313	153	466
1498.3	660	434	1094
1499.3	1084	798	1882
1500.3	1574	1228	2802
1503.3	3363	2843	6206

Data for Dam at Outlet of Subarea A1

Name of Dam: CURTIS Sheet 2 of ___

Outlet Works Rating:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	1464.9		
Invert of Inlet	1465.0±		
Type	CIP		
Diameter (ft) = D	3		
Length (ft) = L	37		
Area (sq. ft) = A	7.07		
N	.014		
K Entrance	0.5		
K Exit	1.00		
K Friction* = $29.1_N{}^2L/R^{4/3}$	.31		
Sum of K	1.81		
$(1/K)^{0.5}$ = C	0.74		
Maximum Head (ft) = HM	35±		
Q = C A $\sqrt{2g(HM)}$ (cfs)	248		
Q Combined (cfs)	≈ 250		

* R = Hydraulic Radius = (Area/Wetted Perimeter) = D/4 for Circular Conduits.

Data for Dam at Outlet of Subarea A1

Name of Dam: CURTIS Sheet 3 of ___

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1444.5 = ELEVO*	0	0	0	
1495.8 = ELEV1	75.14 = A1	418.333	1284 = S1	
1500	100			
1520	155			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at ~~Top of Dam~~ Normal Pool is 5 percent of watershed.

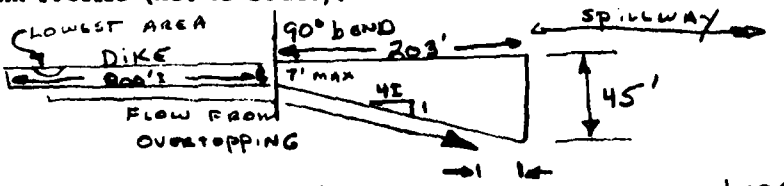
Remarks: ___

Data for Dam at Outlet of Subarea A1

Name of Dam: CURTIS Sheet 4 of ___

Breach Data:

Sketch of Dam Profile (not to scale):



Sketch of Top of Dam (not to scale): 20' ESTIMATED BREACH WIDTH

Soil Type from Visual Inspection: SILT

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) 2.0 fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) $A = L \cdot depth$

HMAX = $(4/9\ V^2/C^2)$ = 0.18 ≈ .2 ft., C = 3.1

.2 + 1497.8
HMAX + Top of Dam Elev. = 1498.0 = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 20 ft (width of bottom of breach)

Z = 2 (side slopes of breach) = 1/2 (1V on 4H)

ELBM = 1454.3 (bottom of breach elevation, minimum of zero storage elevation)

WSEL = 1495.8 (normal pool elevation)

T FAIL = 18 mins (6 mins to develop breach in dike
12 mins to develop breach in main dam because of erosion at toe.)
= 0.3 hrs (time for breach to develop)

SUSQUEHANNA River Basin

Name of Stream: WHITE OAK RUN

Name of Dam: CURTIS

NDI ID No.: PA-00370

DER ID No.: 35-17

Latitude: N 41° 22' 30" Longitude: W 75° 30' 50"

Drainage Area: 2.4 sq. mile

Data for Subarea: A1 (see ~~Sketch on Sheet~~ PLATE C-1)

Name of Dam at Outlet of Subarea: CURTIS

Drainage Area of Subarea: 2.4 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 1.9 mile

L_{CA} = Length of Main Watercourse to the centroid = 1.0 mile

From NAB Data: AREA 11, PLATE E

Cp = 0.62

C_T = 1.50

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 1.82 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 3.6 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea B
(see Sketch on Sheet C-4)

Name of Dam: ELMHURST Sheet 1 of ___

Height: 64 FEET (existing)

Spillway Data: FROM PHASE I REPORT	Existing Conditions	Design Conditions
Top of Dam Elevation	SAME →	1431.5
Spillway Crest Elevation		1422.5
Spillway Head Available (ft)		9.0
Type Spillway		MASONRY GRAVITY
"C" Value - Spillway		3.97*
Crest Length - Spillway (ft)		153.3
Spillway Peak Discharge (cfs)		16,432
Auxiliary Spillway Crest Elevation		1422.5
Auxiliary Spillway Head Available (ft)		9.0
Type Auxiliary Spillway		CONCRETE CHUTE
"C" Value - Auxiliary Spillway		3.97*
Crest Length - Auxiliary Spillway (ft)		136.0
Auxiliary Spillway Peak Discharge (cfs)		14,578
Combined Spillway Discharge (cfs)		31,000

Spillway Rating Curve:

* MODEL TEST RESULTS

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

Data for Dam at Outlet of Subarea B

Name of Dam: ELMHURST Sheet 3 of __

Storage Data: FROM PHASE I REPORT

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1387.4 = ELEVO*	0	0	0	
1422.5 = ELEV1	181 = A1		2115 = S1	
1431.5	185			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is N/A percent of watershed.

Remarks: _____

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SELECTED COMPUTER OUTPUT

ITEM	PAGE
MULTI RATIO ANALYSIS:	
INPUT	C-12
SYSTEM PEAK FLOWS	C-13
CURTIS DAM	C-14
BREACH ANALYSIS*	
INPUT	C-15
SYSTEM PEAK FLOWS	C-16
CURTIS DAM	C-17
ELMHURST DAM	C-18

* NOTE: PLAN 1 - NO DAM FAILURE
PLAN 2 - CURTIS DAM FAILS FOR 50% PMF ONLY

SYSTEM IS SHOWN ON PLATE C-1

0313

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
```

1	A1				NATIONAL DAM INSPECTION PROGRAM						
2	A2				WHITE OAK RUN						
3	A3				CURTIS DAM						
4	B	300	0	15	0	0	0	0	0	-4	0
5	B1	5									
6	J	1	7	1							
7	J1	1	.5	.4	.3	.2	.1	.05			
8	K		1					1			
9	K1		RUNOFF INTO CURTIS RESERVOIR								
10	M	1	1	2.4		2.4				-4	
11	P		21.3	118	127	136	142	145			
12	T							1.0	.05		.05
13	W	1.82	.62								
14	X	-1.5	-0.05	2.0							
15	K	1	1					1			
16	K1		ROUTE THROUGH CURTIS DAM								
17	Y				1						
18	Y1	1						-1495.8	-1		
19	Y4	1495.8	1496.3	1497.3	1498.3	1499.3	1500.3	1503.3			
20	Y5	0	66	466	1094	1882	2802	6206			
21	$A	0	75.14	100	155						
22	$E	1444.5	1495.8	1500	1520						
23	$S	1495.8									
24	$D	1497.8									
25	$L	1	65	140	300	340	800	865	1040	1100	1225
26	$V	1497.8	1498.2	1498.6	1499.2	1499.3	1499.4	1499.7	1499.8	1499.9	1505
27	K	99									

C-12

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .20	RATIO 6 .10	RATIO 7 .05
HYDROGRAPH AT	1	2.40	1	6463.	3232.	2585.	1939.	1293.	646.	323.
	(	6.22)	(	183.02)(	91.51)(	73.21)(	54.91)(	36.60)(	18.30)(	9.15)(
ROUTED TO	1	2.40	1	6373.	3010.	2278.	1605.	972.	429.	198.
	(	6.22)	(	180.45)(	85.23)(	64.51)(	45.45)(	27.52)(	12.14)(	5.60)(

C-13

CURT
7
A

SUMMARY OF DAM SAFETY ANALYSIS

CURTIS DAM

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1495.80	1495.80	1497.80
STORAGE	1285.	1285.	1446.
OUTFLOW	0.	0.	780.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1500.23	2.43	1675.	6373.	9.75	41.75	0.00
.50	1499.49	1.69	1602.	3010.	7.00	42.00	0.00
.40	1499.18	1.38	1571.	2278.	6.00	42.25	0.00
.30	1498.73	.93	1530.	1605.	5.00	42.50	0.00
.20	1498.09	.29	1472.	972.	2.75	42.75	0.00
.10	1497.21	0.00	1396.	429.	0.00	43.25	0.00
.05	1496.63	0.00	1349.	198.	0.00	43.25	0.00

41-D

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  21 FEB 79
**********************************
```

DATA FOR DAM BREAK

S1-7

```
    1  A1                    NATIONAL DAM INSPECTION PROGRAM
    2  A2                          WHITE OAK RUN
    3  A3                          CURTIS DAM
    4  B     300       0       15       0       0       0       0       0      -4       0
    5  J1      5
    6  J       2       1        1
    7  J1    .5
    8  K                       1                                       1
    9  K1       RUNOFF INTO CURTIS RESERVOIR
   10  M       1       1     2.4              2.4                                      1
   11  P               21.3     118      127     136      142     145
   12  T                                                        1.0     .05             .05
   13  W    1.82     .62
   14  X    -1.5   -0.05     2.0
   15  K       1       1                                       1
   16  K1       ROUTE THROUGH CURTIS DAM
   17  Y                                       1       1
   18  Y1      1                                                       -1495.8      -1
   19  Y41495.8  1496.3  1497.3  1498.3  1499.3  1500.3  1503.3
   20  Y5      0      66     466    1094    1882    2802    6206
   21  $A      0   75.14     100     155
   22  $E1444.5  1495.8    1500    1520
   23  $S1495.8
   24  $D1497.8
   25  $L      1      65     140     300     340     800     865    1040    1100    1225
   26  $V1497.8  1498.2  1498.6  1499.2  1499.3  1499.4  1499.7  1499.8  1499.9    1505
   27  $B     20       2  1454.3     0.3  1495.8  1500.0
   28  $R     20       2  1454.3     0.3  1495.8  1498.0
   29  K       1       2                                       1
   30  K1       STRM SECT. 2  BETWEEN CURTIS AND ELMHURST
   31  Y                                       1       1
   32  Y1      1                                                       -1
   33  Y6    .09     .07     .09    1440    1480    2000    .011
   34  Y7      0    1600     350    1540     510    1500     740    1440    1490    1440
   35  Y7   1600    1460    1800    1480    2000    1500
   36  K       1       3                                       1
   37  K1       ELMHURST RESERVOIR
   38  Y                                       1       1
   39  Y1      1                                                       -1422.5       0
   40  $A      0     121     185
   41  $E1387.4  1422.5  1431.5
   42  $S1422.5   289.3    3.97     1.5
   43  $D1431.5     3.1     1.5      97
   44  $B    100       2    1390     1.0  1422.5    1480
   45  $B    100       2    1390     1.0  1422.5    1480
   46  K      99
```

CURT
7
8

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .50
HYDROGRAPH AT	1	2.40	1	3232.
	(	6.22)	(	91.51)(
			2	3232.
			(	91.51)(
ROUTED TO	1	2.40	1	3010.
	(	6.22)	(	85.23)(
			2	42379.
			(	1200.03)(
ROUTED TO	2	2.40	1	2986.
	(	6.22)	(	84.55)(
			2	36116.
			(	1022.68)(
ROUTED TO	3	2.40	1	2501.
	(	6.22)	(	70.83)(
			2	15190.
			(	430.13)(

RATIOS APPLIED TO FLOWS

C-16

SUMMARY OF DAM SAFETY ANALYSIS

CURTIS DAM

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1495.80	1495.80	1497.90
STORAGE	1285.	1285.	1446.
OUTFLOW	0.	0.	780.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1499.49	1.69	1602.	30110.	7.00	42.00	0.00

PLAN 2 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1495.80	1495.80	1497.90
STORAGE	1285.	1285.	1446.
OUTFLOW	0.	0.	780.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1499.16	.36	1479.	55357.	.62	40.30	40.00

C-17

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2986.	1441.1	42.25

PLAN 2 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	36116.	1446.3	40.50

SUMMARY OF DAM SAFETY ANALYSIS

ELMHURST DAM

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1422.50	1422.50	1431.50
STORAGE	211?.	2118.	3765.
OUTFLOW	0.	0.	31010.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1424.19	0.00	2422.	2501.	0.00	43.25	0.00

PLAN 2 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1422.50	1422.50	1431.50
STORAGE	211?.	2118.	3765.
OUTFLOW	0.	0.	31010.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1429.09	0.00	3137.	15190.	0.00	40.75	0.00

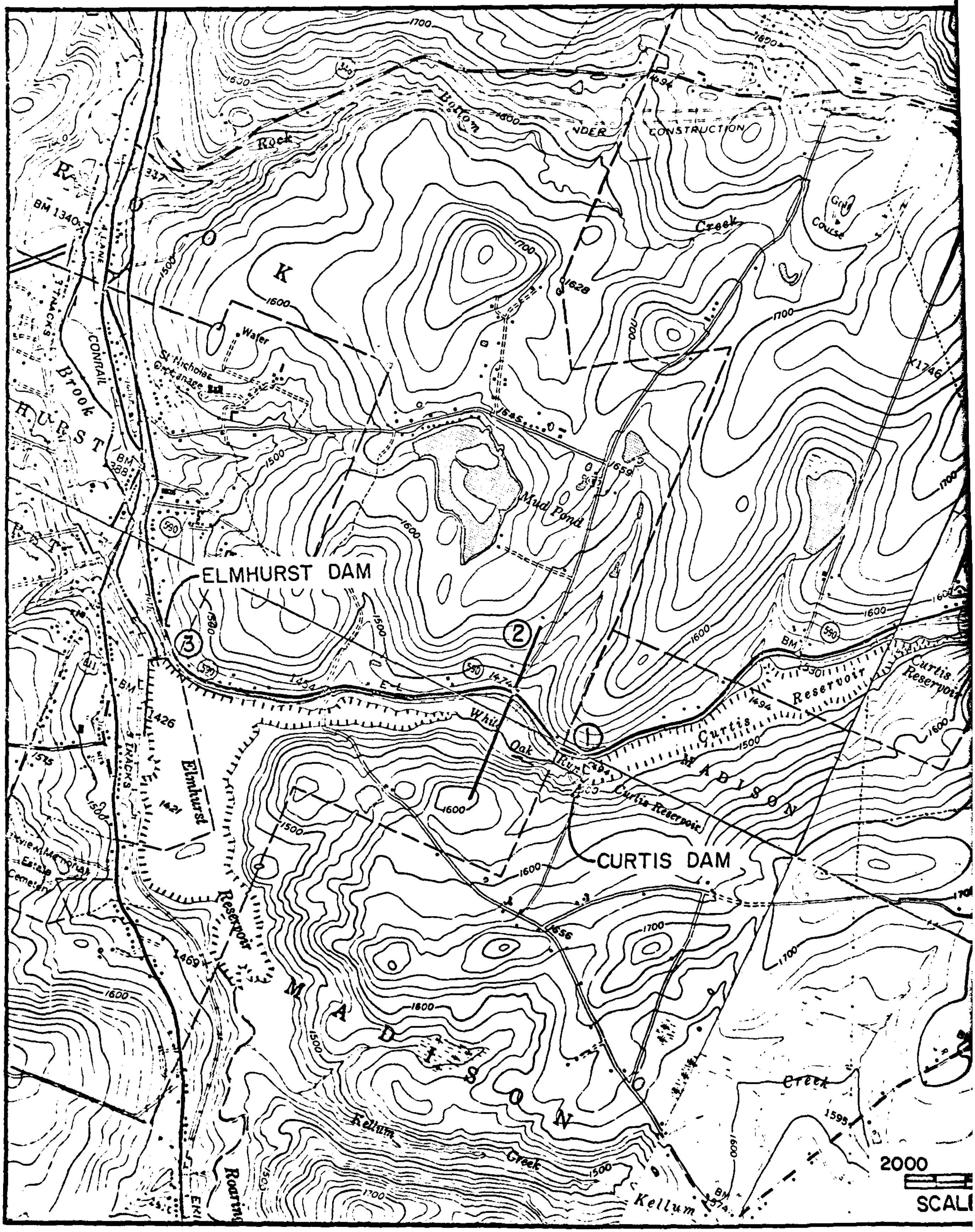
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

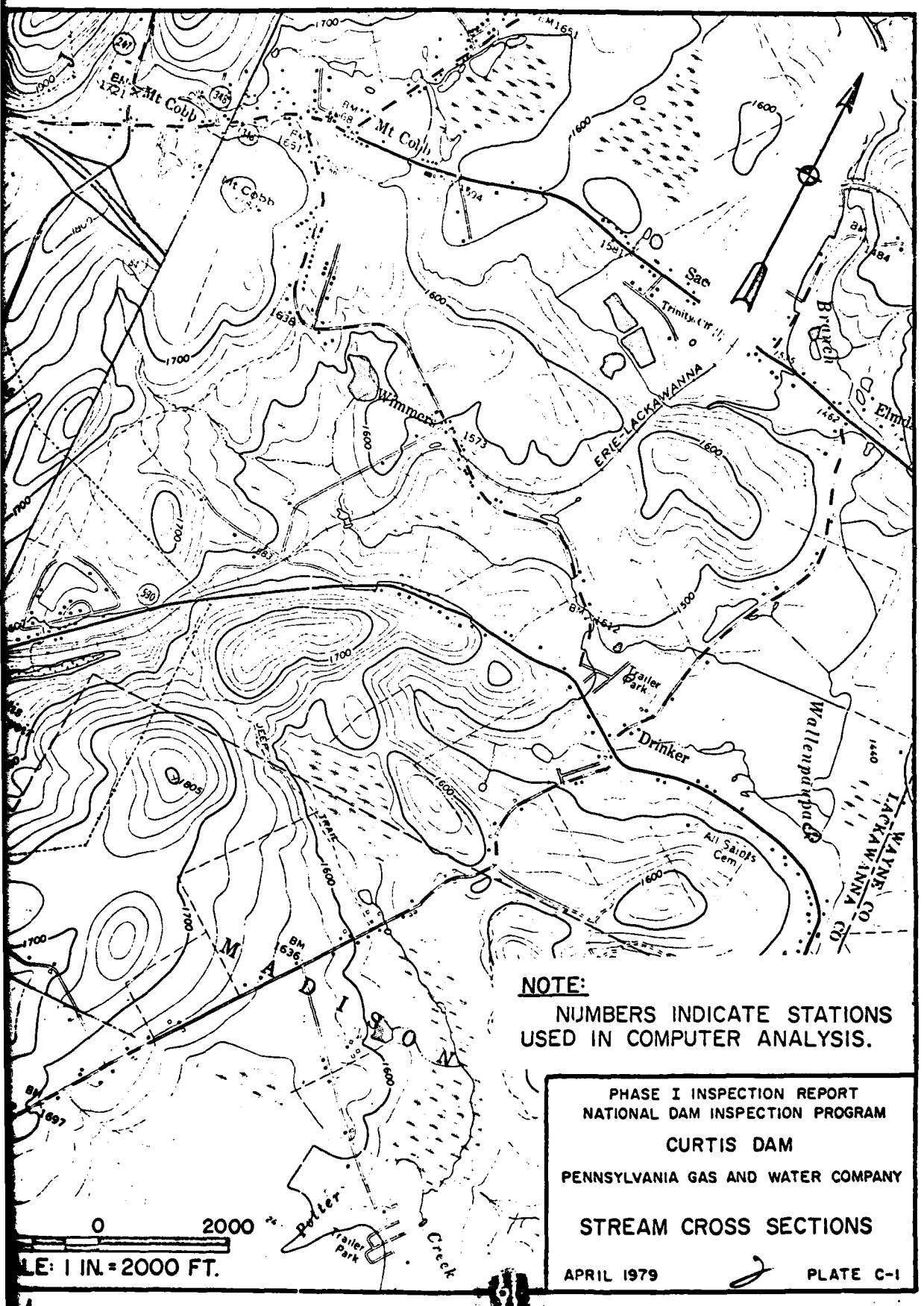
SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SUMMARY OF PERTINENT RESULTS
(DAM WITH EXISTING CONDITIONS)

PMF RAINFALL = 24.7"

	PMF	½ PMF
CURTIS DAM		
RUNOFF (INCHES)	22.2	11.1
PEAK INFLOW (CFS)	6463	3232
PEAK OUTFLOW (CFS)	6373	3010
DEPTH OVERTOPPING (FT)	2.43	1.69
DURATION OVERTOPPING (HRS)	9.75	7.00


ELMHURST DAM
CURTIS DAM
Mud Pond
Elmhurst
Reservoir
Curtis Reservoir
MADISON
Kellum Creek
White Oak Run
Rock Bottom
UNDER CONSTRUCTION
St Nicholas Orphanage
Golf Course
CONRAIL
Brook
Water
2000
SCALE



NOTE:

NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

CURTIS DAM

PENNSYLVANIA GAS AND WATER COMPANY

STREAM CROSS SECTIONS

APRIL 1979

PLATE C-1

SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

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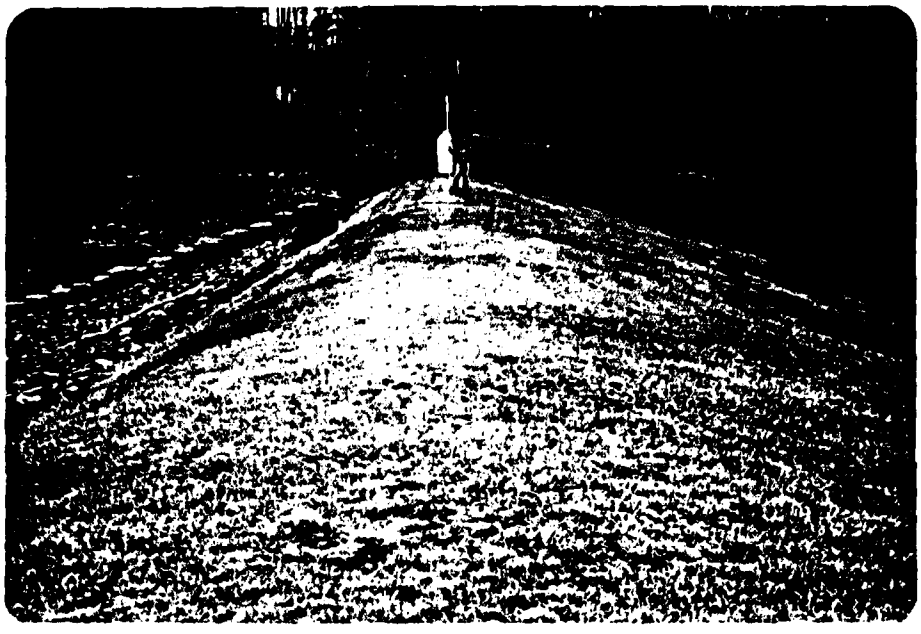
NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

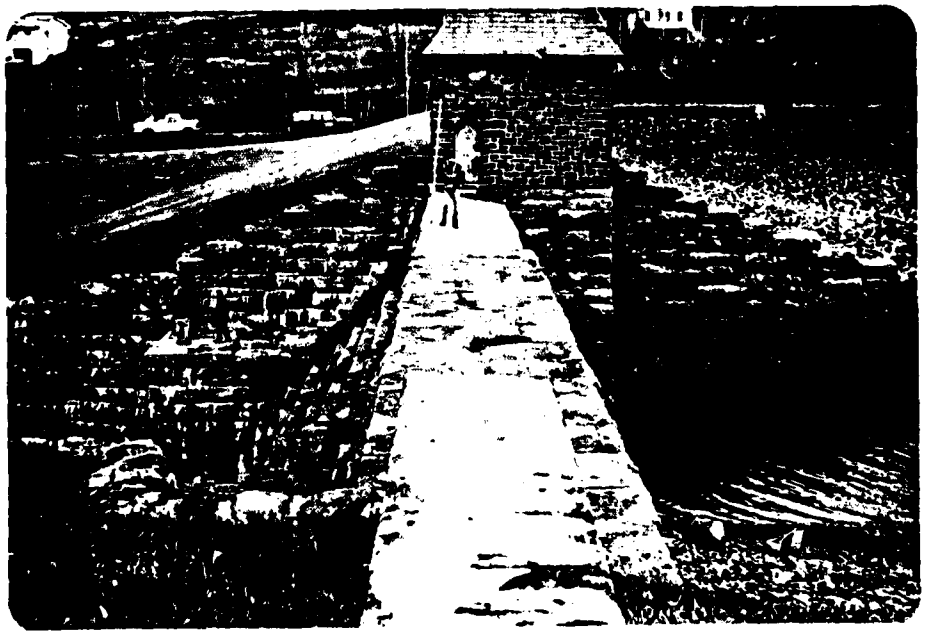
APPENDIX D

PHOTOGRAPHS

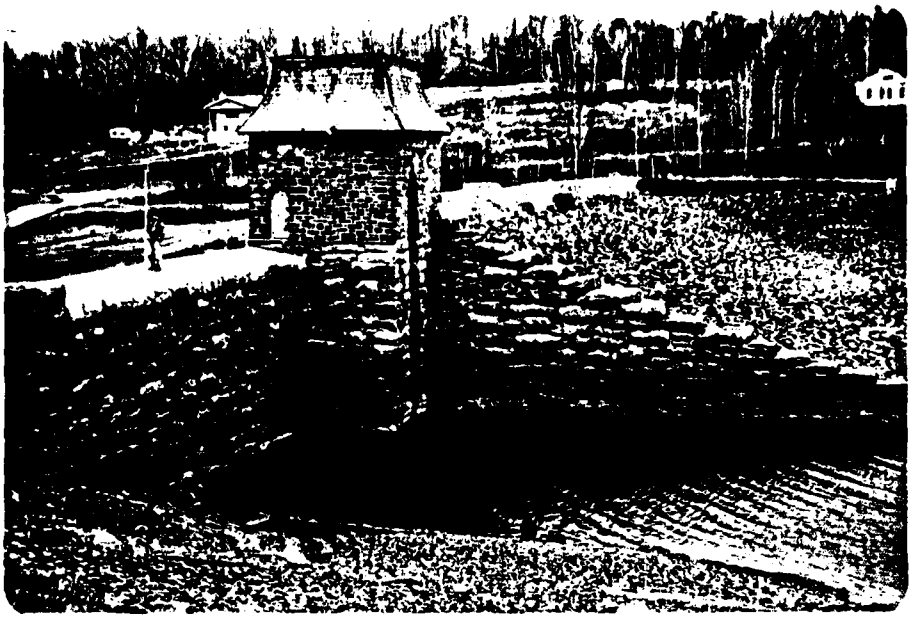
CURTIS DAM



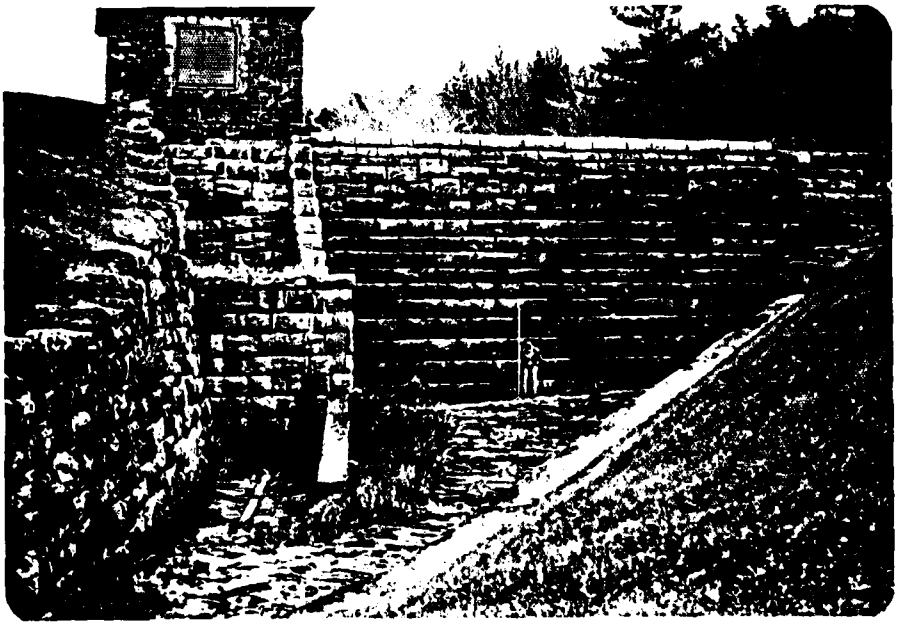
A. Top of Dam - from Right Abutment



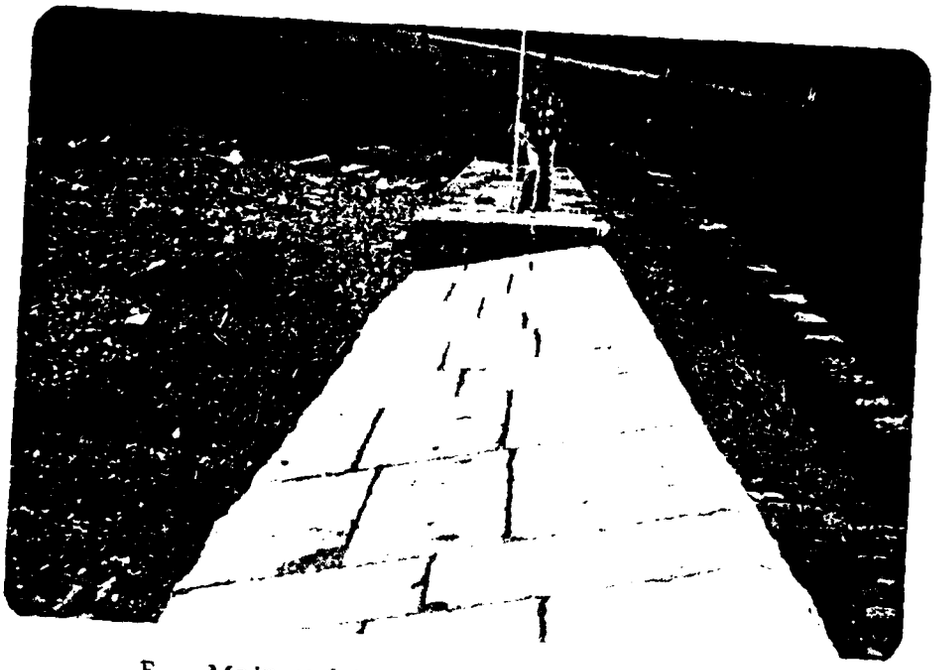
B. View from Left Abutment



C. Spillway Approach and Upstream Slope



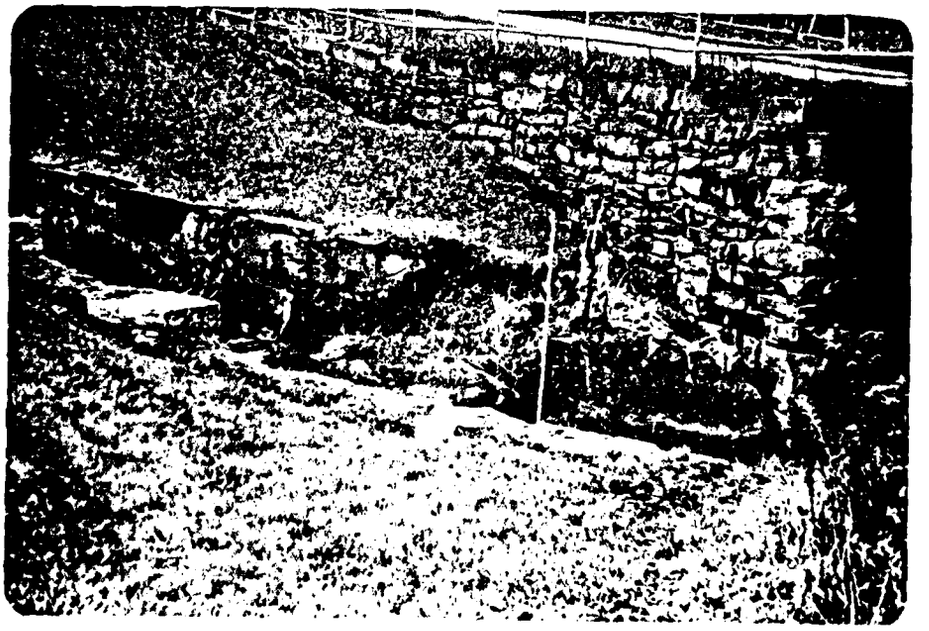
D. Spillway, Auxiliary Spillway, and Outlet Works



E. Main and Auxiliary Spillway Crest

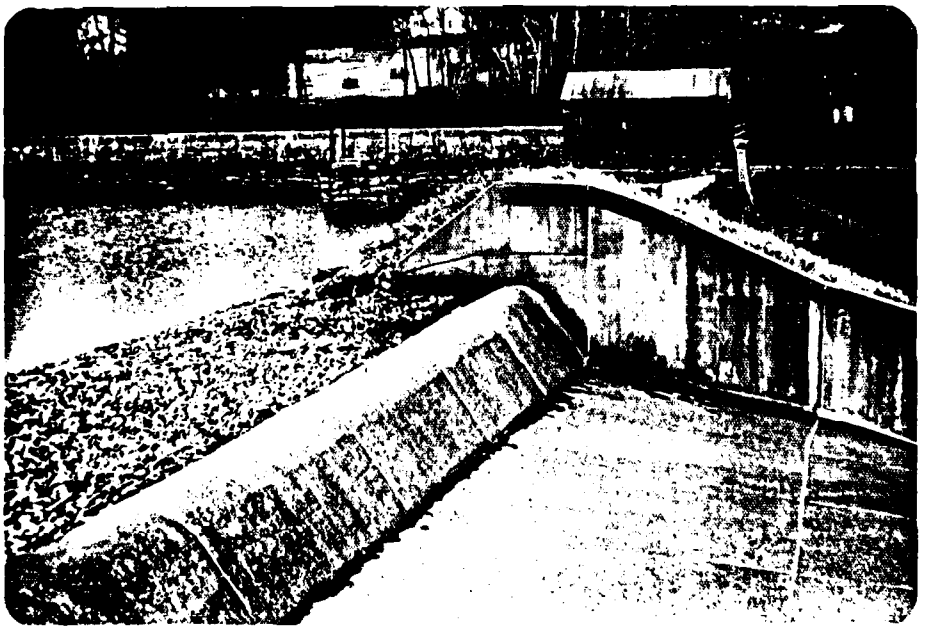
F. Auxiliary Spillway Apron

G. Spillway Channel



H. Left Spillway Training Wall

I. Fill on Top of Railroad Floodwall



J. Elmhurst Dam - Downstream of Curtis Dam

AD-A079 026 GANNETT FLEMING CORDDRY AND CARPENTER INC HARRISBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. CURTIS DAM (NDI ID NUMBER PA-0--ETC(U)
APR 79 A C HOOKE DACW31-79-C-0015

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SUSQUEHANNA RIVER BASIN

WHITE OAK RUN, LACKAWANNA COUNTY

PENNSYLVANIA

CURTIS DAM

NDI ID No. PA-00370
DER ID No. 35-17

PENNSYLVANIA GAS AND WATER COMPANY

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APPENDIX E

GEOLOGY

CURTIS DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene Time. The general direction of ice movement was S 35° - 40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southwest, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville formations (youngest) through the Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of the Lackawanna Syncline, are generally horizontally stratified.

The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain is quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a torturous course to their

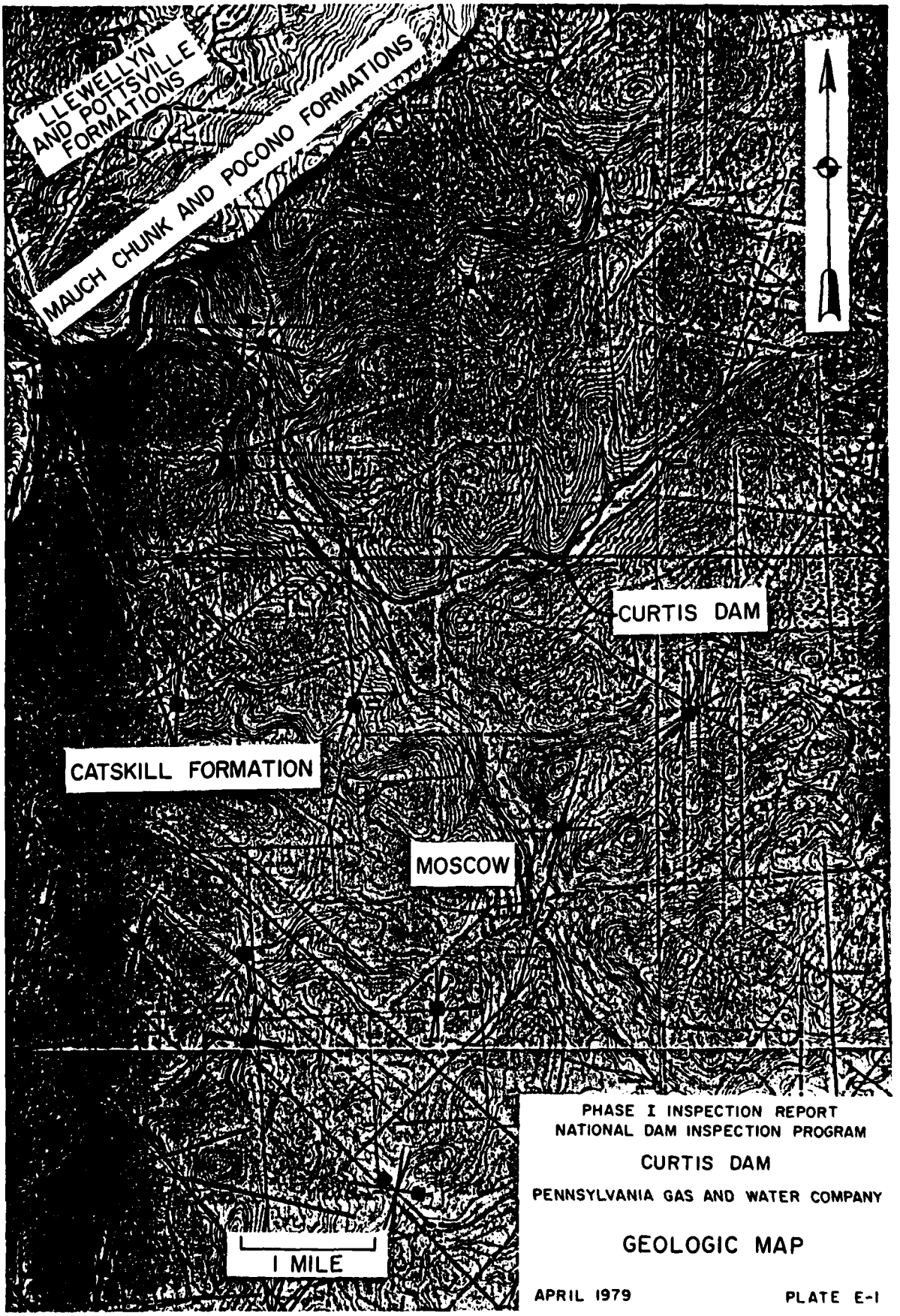
confluence with the Lackawanna River near Scranton. Northwest of the Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the country flows westward by way of Tunkhannock Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed is founded in post-Pottsville formations. Proceeding uphill from the river, the older Pottsville formation, Mauch Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. Curtis Dam is founded on the Catskill Sandstones of late Devonian Age on the left (south) end and a mixture of stiff clay, sand and gravel elsewhere. An excerpt from The Pennsylvania Water Supply Commission Report of 1914 states that:

> "The geological formation at the dam is similar to that at the Elmhurst Dam. A rock outcrop of Pocono or Catskill sandstone occurs along the south hillside, and at the point where the dam is built this rock formation continues to about the middle of the stream, where it breaks off abruptly, the remainder of the bed of the stream and the opposite bank being mostly a mixture of stiff clay, sand and gravel. This necessitated a structure built half on rock and half on material of less bearing value, but the rock outcrop at the south end afforded a good foundation for the gate and screen chambers, spillway and abutment, and the floor for the run-off channel of the blow-off."

Curtis Dam is located in the Pocono Plateau section. Structure in the area is that of a dissected plateau with virtually horizontal strata. The Catskill formation is composed of dark red shale, claystone and siltstone; gray, fine to medium grained sandstone, and coarse grained con-

glomerates. Crossbedding, channeling and cut-and-fill features are common to the sandstone and conglomerate units. Siltstone predominates in the lower part of the formation. The predominant joint set trends approximately N 10° - 20° E. Bedding is generally well developed with thicknesses ranging from one foot to ten to sixteen feet in the coarser more competent beds.



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NATIONAL DAM INSPECTION PROGRAM

CURTIS DAM

PENNSYLVANIA GAS AND WATER COMPANY

GEOLOGIC MAP

APRIL 1979

PLATE E-1